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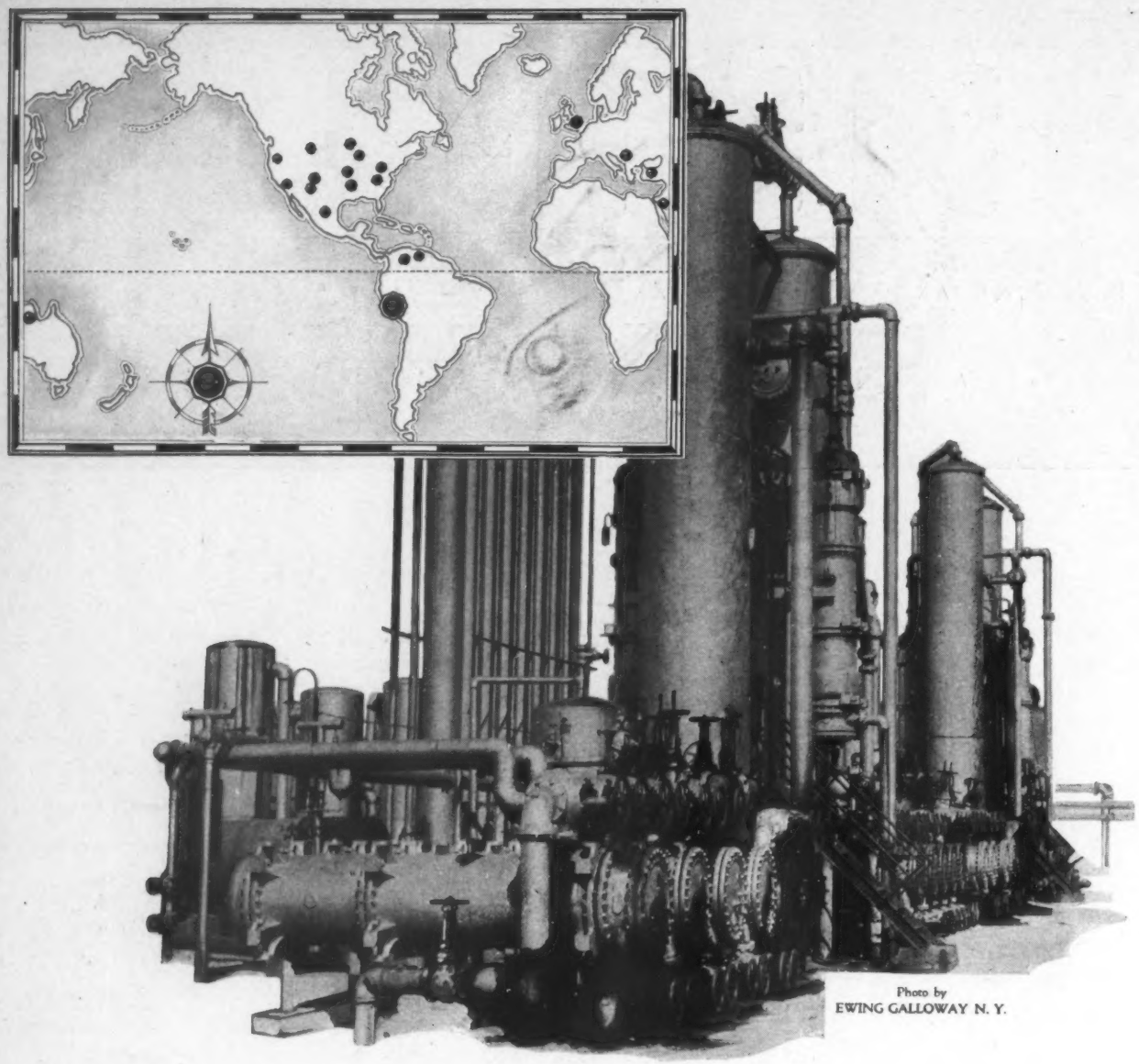

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AUGUST, 1930

GRADY TRIPLETT, *Editor*

GEORGE REID, *Associate Editor*

TABLE OF CONTENTS

Modernizing the Skimming Plant 67
By R. Werlin

Old Equipment Rearranged, Result: Modern Plant 69
By George Reid

Lime Distributing Plants to Combat Corrosion 73
By R. J. Lawrence

Editorials 76

Hydrogenation of Mineral Oils 77
By I. M. Beall

An Investigation of Treated Clays 83
By J. E. Meyer

Richland Field Adsorption Plant 87
By A. J. Mackinnon

Practical Results With the Edeleanu Process 89
By Dr. J. Rosenberg

Arkansas Natural Gas' Cartersville Plant 94

United Refinery Company Plant Makes Many Special Products 96

Chemical Treatment of Petroleum Distillates 99
By L. J. Catlin

Still Runs Should Not Exceed 2,570,000 Barrels 108
By H. J. Struth

Methods of Utilizing Petroleum Residues and By-Products 120
By Dr. A. E. Dunstan

Plant Men and Methods 130

Cutting Cost of Coke Removal 134
By R. B. Williams

Western Petroleum Refiners Association Committees 136

Natural Gasoline Association Committees 138

Refinery Capacity Expansion Continued During July 142

Refinery and Gasoline Plant Activities 145

New Equipment for the Modern Plant 151

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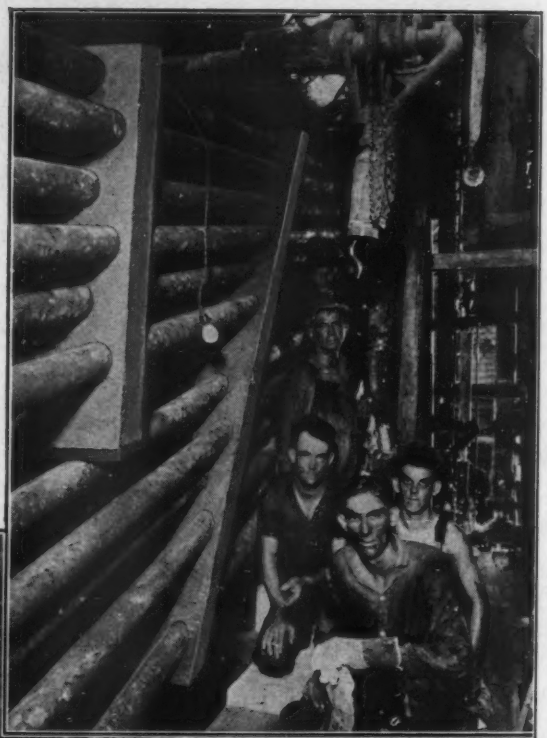

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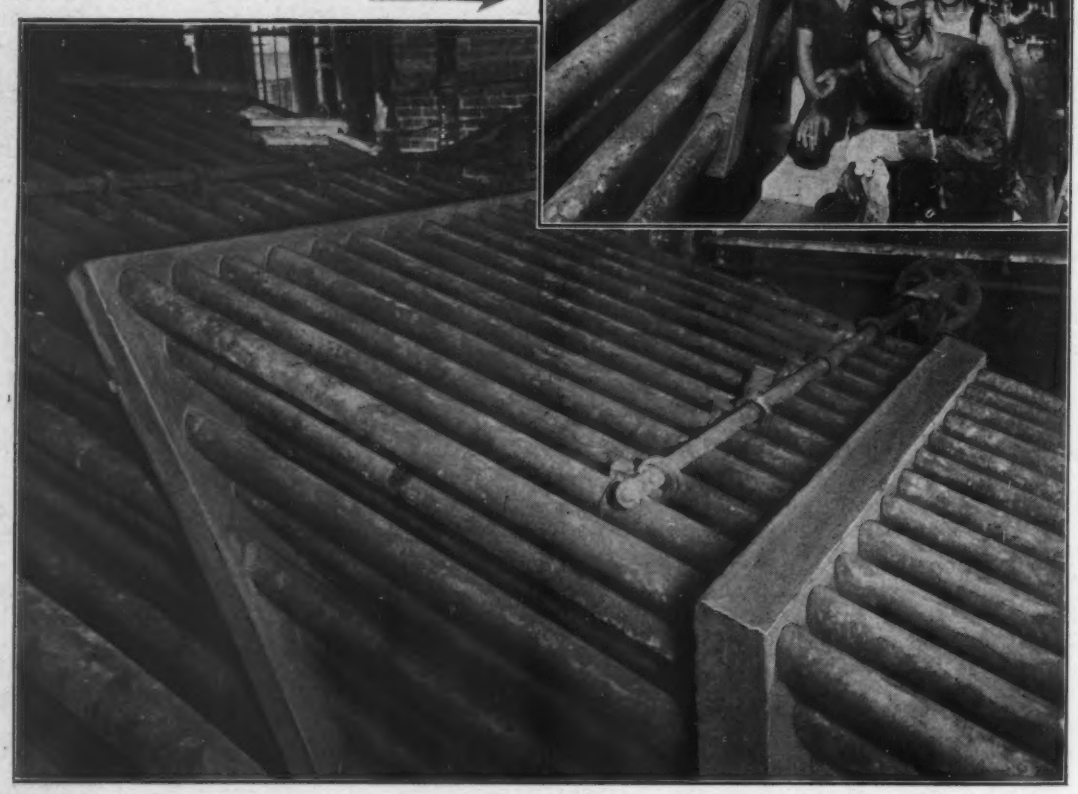

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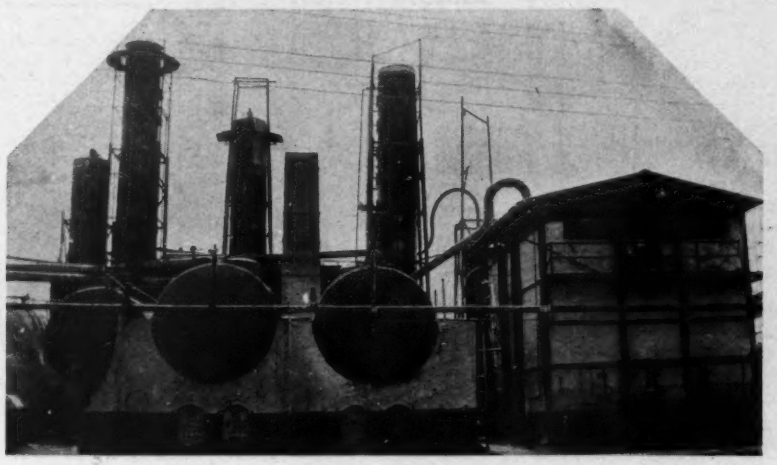
VOLUME 9, No. 8 AUGUST, 1930



The stripping tower is shown at the rear of the flash tower. Peerless Oil & Refining Company.

The two taller columns were connected in series when the process system was redesigned.

Modernizing the Skimming Plant

By R. WERLIN

Superintendent, Peerless Oil & Refining Company, Chanute, Kansas

ORIGINALLY one of the oldest refineries in the Mid-Continent field, the present refinery of Peerless Oil & Refining Company, at Chanute, Kansas, has been operated by its present owners since 1921.

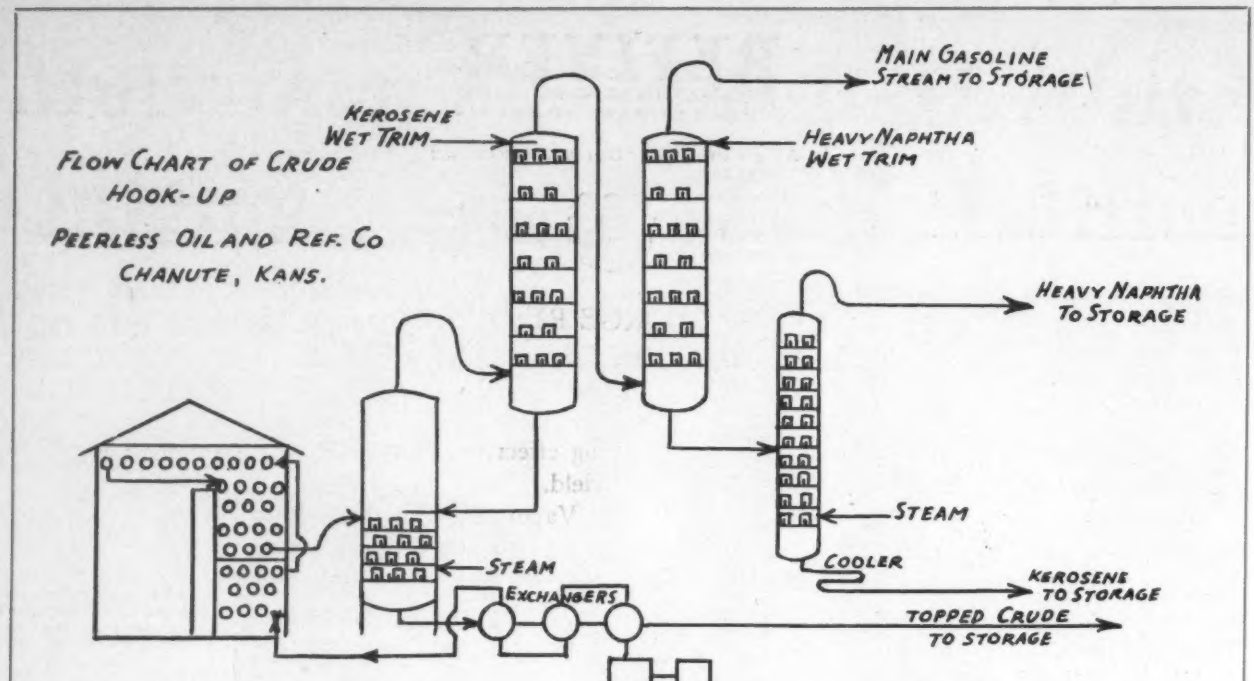
Built about 1907 by L. L. Marcell who operated it for a number of years as Chanute Refining Company, it passed successively into the hands of Cudahy Refining Company, Sinclair Refining Company, and to its present owners who bought it from Sinclair Refining Company while in the process of being junked by the latter company.

Until about four years ago, its present owners operated it purely as a skimming plant, the products being gasoline, kerosene and light fuel oil. The equipment was of the conventional type shell stills, five in number, originally operated as batch stills later connected into a continuous battery and equipped with individual bubble towers.

About four years ago two Jenkins cracking units were installed and since these required gas oil as charging stock, a Winkler-Koch pipe still reducing unit was installed. This unit took the skimmed crude from the last shell still, and further reduced the crude, taking off a large cut of gas oil overhead and leaving a fuel of 12-14 gravity.

Following the writers connection with this company about three years ago, an operation was successfully developed whereby the Jenkins units operated solely on topped crude and recycle stock from the units. This, of course, eliminated the necessity of a reducing unit for the production of gas oil and the following portion of this paper is a description of a hook-up developed to utilize the pipe still as a topping unit. Its advantages as such, over a shell still battery being very obvious.

Since the fractionating equipment of the pipe still consisted only of a six by 25-inch flash chamber and a five by 25-inch shell tower, quotations were first obtained from equipment manufacturers for a single large bubble tower to supply the necessary cuts from the crude. These quotations indicated that an outlay of at least $30,000 would be required. This amount being greater than it was desired to spend, the existing equip-



ment was called into play and the hook-up shown on the inclosed flow-chart was developed. Obviously a hook-up requiring the least expenditure was to be desired and with this in mind as much of the existing equipment as possible was included in the rearrangement.

First, four bubble plates spaced two feet apart were installed in the flash chamber below the pipe still oil inlet to act as a stripping section, steam being introduced between the two lower plates to accomplish this stripping action. The vapors then passed into the first of two five by 35-inch, 15-plate Winkler-Koch bubble towers which were part of the existing equipment of the shell still battery. The back-trap from this tower, was returned to the top plate in the vaporizer and kerosene introduced as wet trim at the top of this tower controlled the quality of the vapor leaving the tower so that nothing heavier than kerosene vapor left the tower. This vapor then passed to the second of these towers, and the main gasoline stream was taken from the top of this tower. The back trap from this tower was allowed to flow by gravity onto the tenth plate of a four by 30-inch bubble tower. This tower was of an obsolete type furnished originally for use on one of the Jenkins units and later replaced by a more modern one. Since it served no purpose in the refinery it was made use of as stripper in which capacity it proves very satisfactory. It contained 22 plates, 10 inches apart but cast so as to rest one in the other. In order to save pumping the back-trap from the second tower and to prevent moving the equipment this tower was set up low enough that the back-trap from the second bubble tower would flow freely by gravity onto the tenth plate. This gave 10 plates to act as a stripping section and 12 above the back-trap inlet to act as a fractionating section. Steam was introduced between the two lowest plates.

NAPHTHA TAKEN FROM TOP

From the top of this stripper a blending naphtha of about 440 EP is taken. This can be run to storage but it is found possible by using this as wet trim in the top of the second tower to blend almost all of it back into the main gasoline stream, so that when making U. S. motor gasoline, the overhead products of the unit consist of only one grade of gasoline and kerosene. When making lower end points there is a small excess of naphtha produced.

The bottoms from this stripper form the kerosene which in this operation is made about 360 IBP, 525 EP and 160°F. flash.

The topped crude from the vaporizer is stripped to an initial boiling point of 550-600°F. and is pumped through a series of three Griscom-Russell exchangers where it is cooled by interchange with crude on the way to the pipe still. The crude being heated by this interchange to about 275°F. The topped crude then passes to cracking stock storage and the crude goes to the pipe still where it is heated to about 575°F.

This hook-up which has been in use for the past six months has resulted in considerably improved yields of gasoline and kerosene, smaller losses and smaller fuel requirements due to the considerably higher fuel economy of the pipe still over the shell stills. Greater ease of control, reduced quantity of oil under treatment, and increased crude capacity are other important advantages of this operation over the older method. And last but not least, the total outlay required to make these changes was less than $2000.

Old Equipment Rearranged, Result: Modern Plant

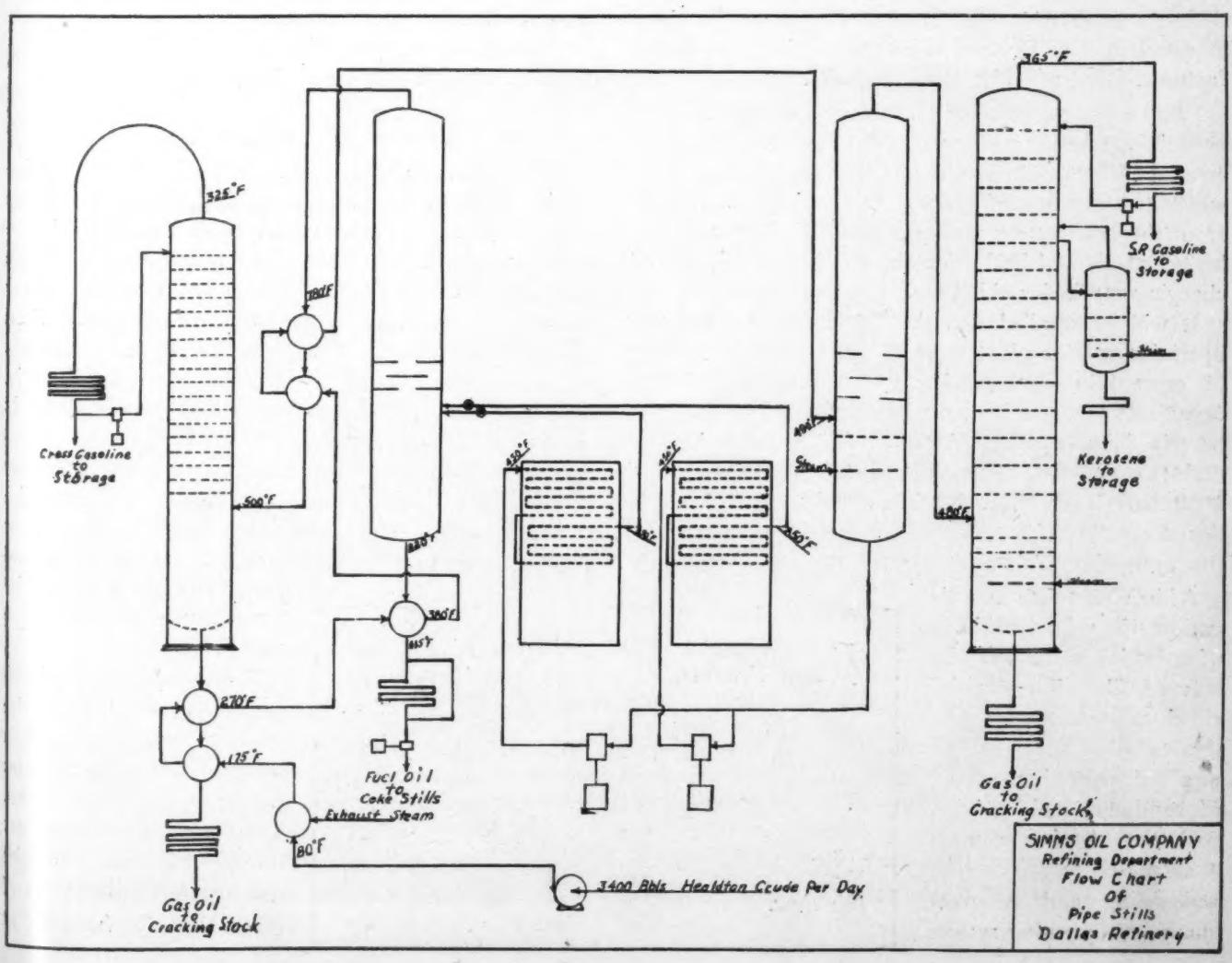
By GEORGE REID
Associate Editor

UPON completion of a remodeling program involving a complete change in operating methods the Dallas plant of Simms Oil Company is processing crude with better efficiency and economy, and a higher charging rate. The reconditioning program recently completed was scheduled in such a manner that very little new equipment was required to effect the desired results, and but little of the existing equipment was moved from its former locations.

Present operation system involves the removal of all virgin gasoline from the Healdton crude through preheating in exchanger equipment before the crude reaches the pipe stills. In the tubular retorts a cracking effect is maintained to produce a maximum gas oil yield.

Vaporization in these units is then carried down to a heavy fuel oil which is later run to coke in regulation coking stills, with the gas oil thus produced charged to the Cross cracking units—these being operated to produce gasoline direct from the unit, recycle stock, a small amount of coke and cracking unit fuel oil.

This method of operation, including the operation of the absorption and stabilizing plant working in conjunction with the topping and cracking system secures a yield of 60 to 62 per cent gasoline from the Healdton



View of the Simms Oil Company plant at Dallas

crude. The stabilization unit, which was designed by Refinery Engineers, Inc., Kansas City, was discussed in detail in The Refiner and Natural Gasoline Manufacturer, issue of July, 1930, page 97.

Prior to conversion to the coking operation for the production of gas oil charging stock the Simms refinery consisted of nine shell stills in continuous battery from which five streams of gasoline were taken. Residuum from the still battery was processed through a Foster heater at about 850°F. for the production of gas oil charging stock for the Cross cracking units.

It will be recalled that the Cross cracking units in operation at this plant were the first of their type to be erected in Texas, being installed by the Clayton organization when it owned the refinery; and of 600 barrels daily capacity. After several months the second two units were erected with rated capacity of 1000 barrels daily, each. These stills have been in operation several years making gasoline direct from the units through bubble type fractionating columns.

After a complete investigation of various methods of operation and the results secured, the company decided to revamp the processing schedule to one of pipe still operation, coking of residuum, and cracking with the two larger units at increased capacity. The remodeling and complete change of operating system was carried out under the supervision of Fred N. Williams, general superintendent of refineries and Frank Gardner, chief engineer, Simms Oil Company, with design and construction by Refinery Engineers, Inc.

IN the article, "Degasification of Pressure Plant Products" appearing on pages 97-104 of the July issue of REFINER AND NATURAL GASOLINE MANUFACTURER *credit was not given Refinery Engineers, Inc., for their part in the work of design and construction of this combination degasification and absorption unit, nor for the flow chart illustrated in the special supplement.* THE REFINER AND NATURAL GASOLINE MANUFACTURER *is glad to give proper credit at this time.*

PIPE STILL OPERATION

The Healdton crude is charged to the skimming facilities at about 80°F. to pass, first, through a large exhaust steam preheater where the temperature is increased to about 175°F. Exhaust steam from the large pumps about the plant is condensed and the water passes through steam traps to be re-used. Oil then passes through two gas oil liquid-to-liquid exchangers where another 100 degrees of heat is imparted to it, and the gas oil leaving the bottom of a bubble tower is reduced in temperature to about 200°F.

The next exchanger equipment is that of residuum or fuel oil liquid-to-liquid exchangers, where the residuum leaving the evaporator at about 800°F. is cooled to about 415°F. and the partially preheated charged crude is raised in temperature from 270°F. to 380°F.

Taking advantage of another source of heat the crude is passed through a series of two exchangers on the gas-oil vapor line. These vapors consist of gas oil and gasoline from the top of the evaporator and enter the exchanger at

780°F. being cooled to about 500°F. at which temperature they enter the side of the bubble tower. The incoming crude is again raised in temperature from 380°F. to 490°F., in this final exchange. At this temperature the oil passes into the side of a combination separator and flash tower—being flashed with steam.

Overhead vapors from the evaporator are taken to the bubble tower at a point three trays high from the bottom accumulator compartment. This tower is also flashed with steam to assure efficient stripping, and the tower-top temperature is controlled by recycling gasoline back over the fourteenth or top tray. At a point five trays down from the top equipment is provided for withdrawing a stream of kerosene distillate into a small flash column, equipped with three trays and steam jet for flashing light vapors back into the side of the main column. Straight run gasoline vapors leave the top of the main column at 365°F. and pass through condensers to storage. Gas oil is withdrawn from the bottom of the main column and taken to pressure still charging stock storage.

This system leaves the topped crude accumulating in the bottom of the first large evaporator from which point it is handled by two pumps and charged to the pipe stills. These two pipe stills are the original retorts constructed with the first installation of two 600-barrel Cross cracking units and are now operating as parallel topping units without any changes in the original furnace design. The system of two tube stills, taking suction on a single evaporator through two pumps, and discharging the heated oil into the side of a common evaporator has certain advantages, primarily in that plant operation is not seriously interrupted in the event of one still being temporarily out of service. The practice of installing duplicate tube stills for this type of operation is followed by other company and similar hook-ups have been discussed in these columns from time to time. In this installation, however, it was not necessary to erect any new equipment in the conversion of the tube stills to skimming work. In this treatment the oil is raised in temperature from 450°F. to 850°F. and sufficient pressure is maintained to effect cracking of about seven per cent of gasoline from the charge. The two transfer lines from both pipe stills lead into the side of the evaporator at a point just below the baffling.

Fuel oil of about nine gravity falls to the bottom of the evaporator in proportion of about 28 per cent of the oil charged. It passes through the two exchangers previously mentioned, through coolers, or a by-pass line around the coolers, and into the coking stills. Two additional coking stills, size 14 by 42 feet, were being installed at the time of the writer's visit, making a total of 10 such stills. These stills are being

This Simms plant was modernized by rearranging old equipment

built by Refinery Engineers, Inc., for Simms Oil Company. This heavy fuel oil yields around 78 per cent gas oil for charging stock to the Cross units. Gases from these stills are handled through the absorption plant.

Vapors from the top of the evaporator consist of gas oil and gasoline, and as already described they are partially cooled in the two exchangers on the vapor line, to enter the side of the bubble column at 500°F. In this column the gasoline is separated from the gas oil through eighteen bubble trays and with gasoline recycled over the uppermost tray. Vapors leave the top of the column at 325°F. through condensers and to accumulators. It is not treated until after stabilization in the degasification unit. This gasoline is a cracked product constituting about seven per cent of the charge.

Gas oil accumulating in the bottom of the column passes through two gas oil to crude exchangers, through coolers and to cracking unit charging stock storage. In this manner gas oil is derived from three points in the system for use as charging stock in the Cross units.

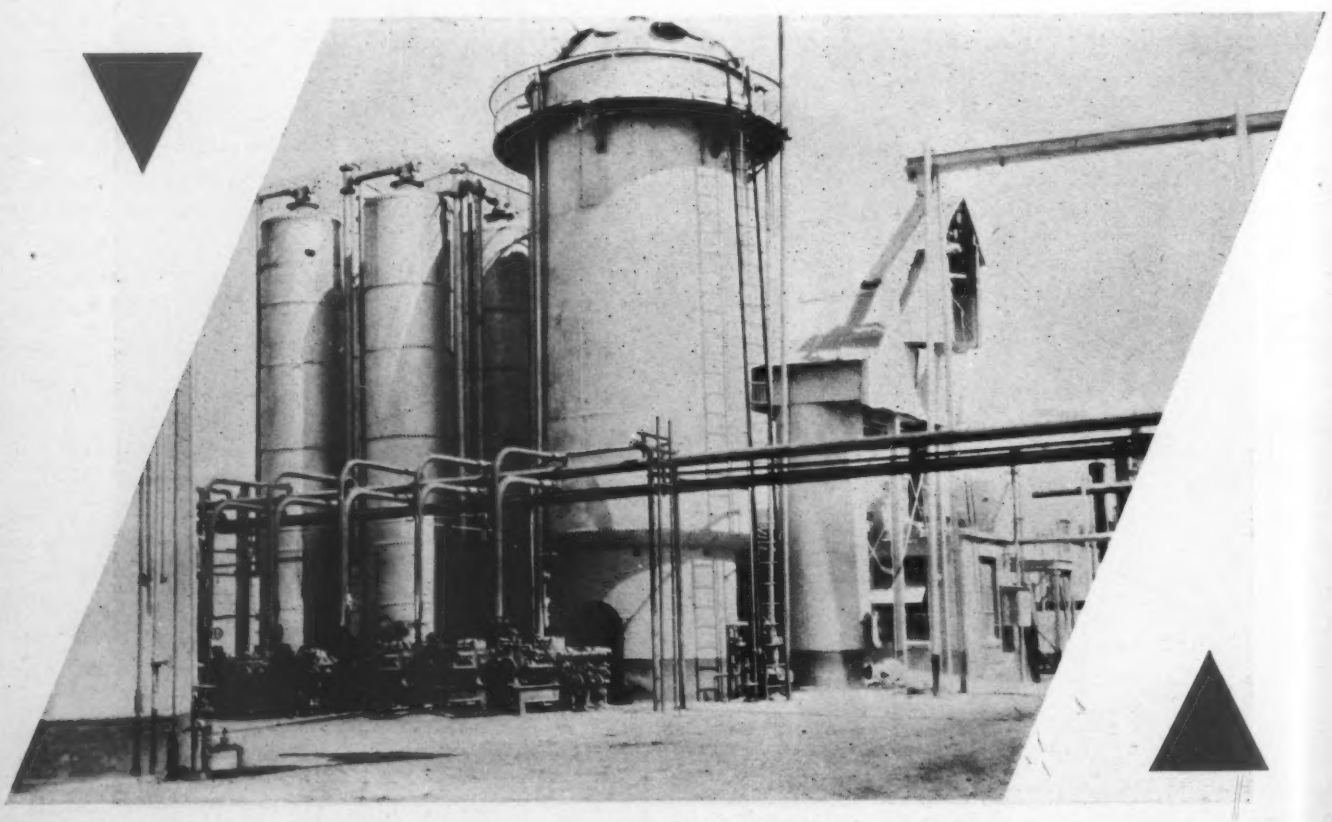
CRACKING

Through the use of hot feed system, with a recycle ratio of 3.1 to one, producing gasoline direct, small quantities of coke, and 7½ to eight A.P.I. gravity Cross-fuel oil, two reaction chambers in series with bottom draw-off, and charging the 1000-barrels plants at the rate of 1400 to 1500 barrels per day, 22-day cycles of operation are maintained.

Fresh feed is charged to a spiral coil in the top of the main bubble tower and through a similar coil in the top of the evaporator, also hot gas oil from the bottom of the bubble tower to accumulator, then through the hot oil pumps to pass through a second and larger spiral coil in the upper part of the evaporator, and into the heating coil or pipe still at a temperature ranging from 620° to 630°F. In the cracking stills the oil is heated to 890° to 895°F. transfer line temperature. It then passes through the two reaction chambers in series which are equipped with bottom draw-off lines, and to the evaporator-fractionation system which produces cracked gasoline direct from the unit.

The subsequent treatment of the cracked gasoline both from the Cross unit and the pipe still operation, and the gases evolved in these two units and their subsequent treatment through the debutanizing plant and the chemical treatment following these steps was discussed in detail in the article previously cited, appearing in the July, 1930, issue of this magazine.

Because of the utilization of facilities for handling and equipment for distillation and fractionation work, the complete modification and improvement of operating efficiency was accomplished at a very reasonable cost figure. The program is an interesting example of what can be accomplished by refinery operators in modernizing a plant through a study of methods and adaptation of facilities on hand to secure desired results.



Treating Department, Simms Oil Company, Dallas

Lime Distributing Plant to Combat Corrosion

By R. J. LAWRENCE
Resident Chemist, Smith's Bluff Refinery, Pure Oil Company

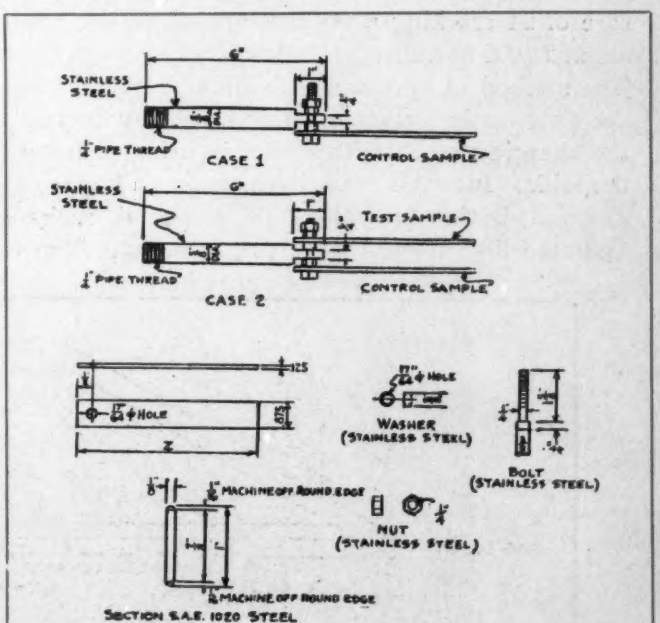
AFTER a few months of processing Winkler crude at the Smith's Bluff refinery considerable difficulty was experienced due to corrosion on the crude tube stills and the battery of cracking units. The original trouble on the tube stills was caused by leaks in the vapor line header in a condenser box. A short time later it became necessary to replace some of the roof tubes of the still and the outlet vapor line to the evaporator, as they had become too thin for further use.

On the cracking stills this rapid corrosion soon gave rise to failure in tubes, return bends, headers and transfer lines. Fortunately no one was injured in any of these failures. Immediately steps were taken toward the elimination of this high rate of corrosion. Careful consideration was given to several methods of reducing the corrosion rate and it was finally decided to employ hydrated lime. The lime treatment was chosen because sufficient amounts of the alkali could be fed into the stills with the charging stock to greatly retard the corrosion, and still not be detrimental to the stills of the products secured.

A number of runs were made using varying amounts of lime per barrel of charging stock, and the corrosion rate measured by inserting strips of steel in the tubes. It was found that .6 pounds of lime per barrel of charging stock was the most satisfactory and while it did not completely stop the corrosion, it was reduced to about that which would be expected from a crude or charging stock of low sulphur content. The use of more lime would doubtless have resulted in trouble in meeting Bunker C Fuel sediment specification. The lime carried over in the fuel causes a white fluffy deposit to collect on the bottoms of the shell stills, which clogs the checker brick work in the furnaces. This is removed every few days by blowing with compressed air. Fuel oil which has been in storage a few days does not cause this trouble; the fuel burned under the stills being a portion of that fuel produced the preceeding 24 hours.

Most of the lime introduced into the cracking stills drops out in the reaction chamber with the coke. This lime mixes with the coke causing it to be fine and flaky instead of the usual hard coke. Each reaction chamber produces several types of coke, varying from coke with only a trace of lime to coke of a light gray color which is about 90 per cent lime. One particular reaction chamber has several times produced coke in small lumps, each lump completely encased in a layer of lime about 1/16 of an inch thick. The inside coke seemed to contain very little lime while the covering was practically all lime. The lime in the coke raises the ash content considerably, the average coke running around 35.0 per cent ash and 12,000 B. T. U. value.

Very little effect has been noted on the hydrogen sulfide content of the gas produced since using lime. The gas made while running on fresh charging stock

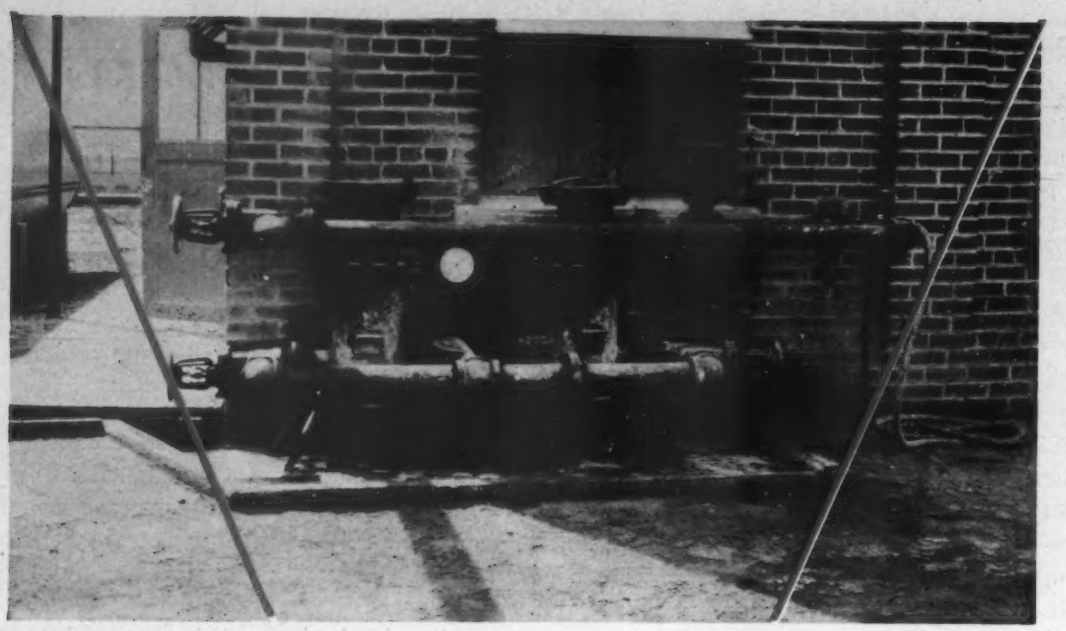


CASE 1:
CONTROL SAMPLE S.A.E. 1020 STEEL SPECIFIC GRAVITY S = 7.833 C.R. = $\frac{1}{H}$
WHERE SAMPLE .125 THICK × .875 WIDE × 3.898 LONG IS USED.

CASE 2:
METAL OF DIFFERENT SPECIFIC GR. OR S' IS USED C.R. = $\frac{1}{H}$ WHERE
SAMPLE .125 THICK × .785 WIDE × Z INCHES LONG, Z = $\frac{2.236}{S'}$.

C.R. = CORROSION RATE OR DEPTH OF PENETRATION IN INCHES PER 1000 HRS.
L = LOSS OF WEIGHT IN GRAMS.
H = HOURS EXPOSED
S = SPECIFIC GRAVITY
Z = LENGTH OF TEST SAMPLE

FIGURE 1



From the mixing tanks the lime-oil mixture is passed through a set of 14-mesh screens housed in the strainers, and into the suction of a small steam pump.

often runs as high as 1800 grains per 100 cubic feet of gas. We have found the lime treatment to be of no help in the later chemical treatment of our pressure distillate which averages around .23 per cent sulfur.

OPERATION AND CONTROL

One of the lime treating plants was built to take care of 24 cracking units through which are passed about 21,000 barrels of charging stock every 24 hours. The method of operating this plant is to fill one of the two vertical open top tanks with 20 barrels of the charging stock with which is being charged to the stills. Into this tank, by means of a hopper and a small bucket elevator, 18 40-pound sacks of hydrated lime is dumped giving a mixture that delivers to the stills at the rate of .4 pounds lime per barrel of charging stock. This is thoroughly mixed with the oil by rotating stirrer turned by a small motor; this mixer stirring the oil and lime continually throughout the pumping out of each batch. An air connection is placed in the bottom of the tanks so that in case of electric or mechanical trouble the operator can continue to agitate the oil and lime. One batch is used up in about one and one-half hours and while pulling from one tank a batch in the other tank is in preparation. From the mixing tanks the lime and oil are passed through a set of 14 mesh screens and into the suction of a small steam pump. From this pump it is discharged into a three-inch line, running the full length of the stills, the excess

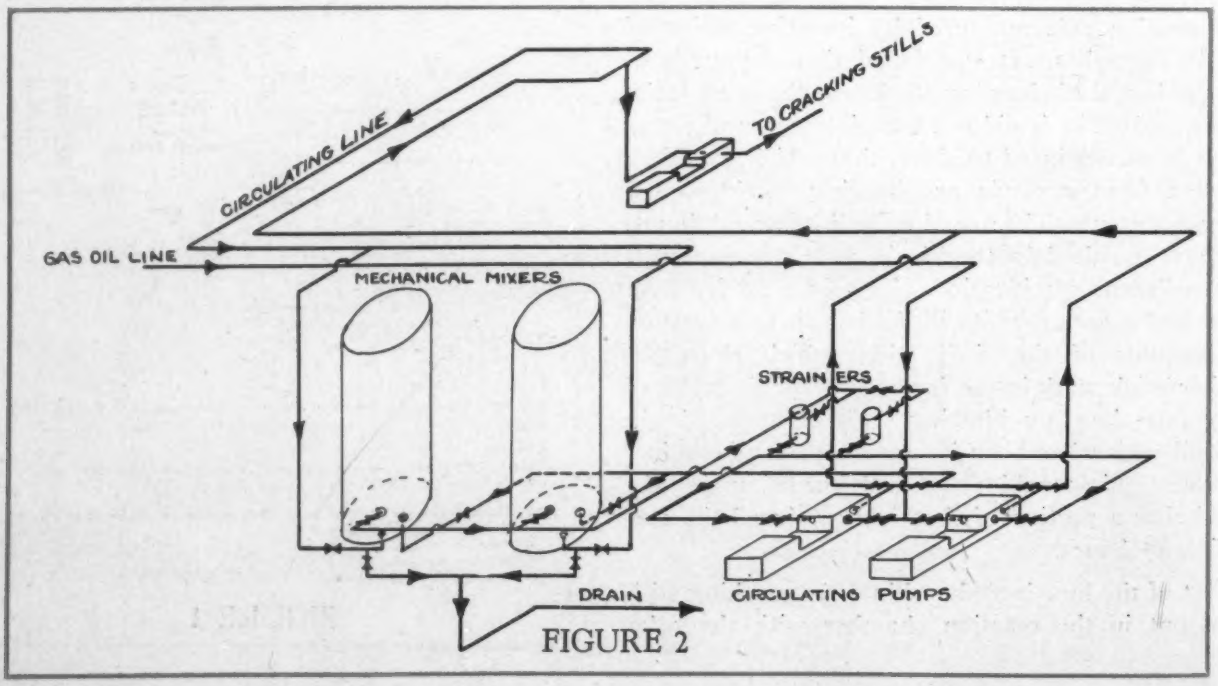
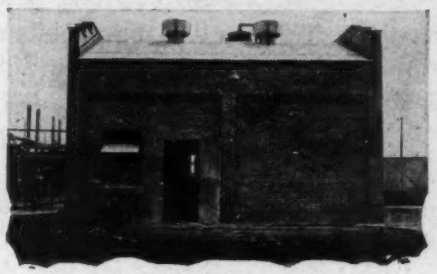


FIGURE 2

oil returning through a two-inch line into the bottom of the tank completing the cycle. This circulating line insures a uniform mixture being delivered to each still. From off the three-inch line and directly behind each still a one-inch line is run into each control house.

This line carries the oil and lime to a small plunger pump; the speed of the stroke of this pump being the same as the stroke of the still's charging pump, as the plunger rod of the lime pump is clamped to the piston rod of the charging pump. This small lime pump operates with a full stroke at all times, the amount of lime charged to the still is controlled entirely by the mixture in the lime mixing tanks. On the side of the line feeding the lime pump is a gauge glass which indicates to the operator whether or not the mixture is feeding to his pump. At intervals the operator opens a valve on a small line on the discharge of the lime pump to be doubly sure he is getting lime into his still.



Lime storage, hopper, bucket elevator and mixing equipment is housed in two or these small buildings of brick and concrete construction

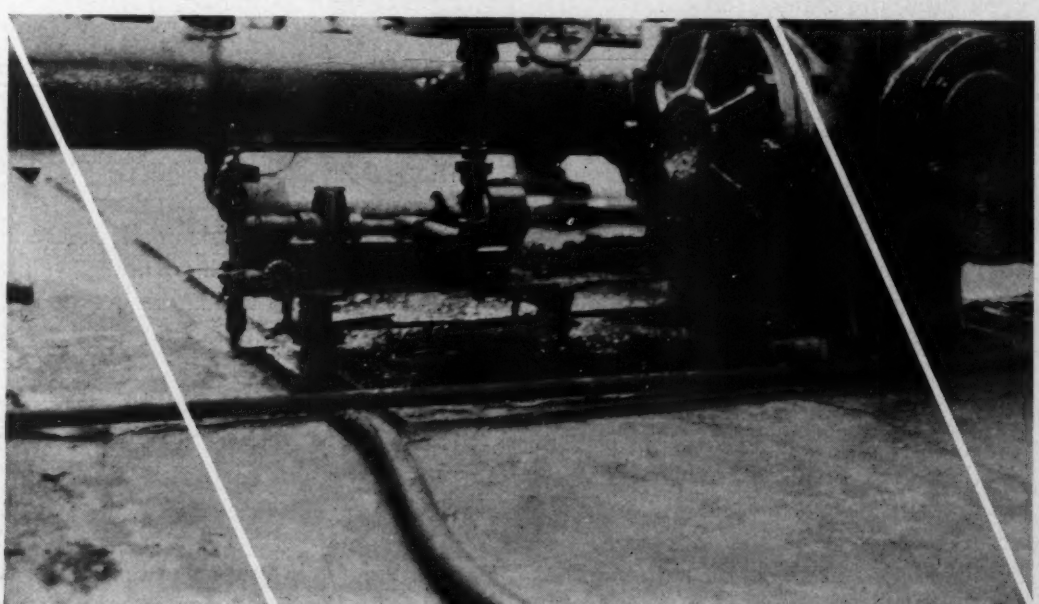
The control of the quantity of lime used and the corrosion rate is handled by the laboratory. In four of the cracking units are placed strips of SAE-1020 steel of uniform size. Three numbered strips are placed in each still, one in the transfer line, one in the last tube of the outlet furnace and the other in the outlet of the reaction chamber. Details of corrosion control sample used will be found in Fig. 1. As soon as a still is shut down, the strips are removed and taken to the laboratory where they are exchange for new weighed strips which are placed in the still before starting up. At the laboratory the corroded strips are carefully cleaned and weighed; this weight being subtracted from the previous weight.

The difference in weight divided by the number of hours the still has been on the line is considered the corrosion rate. All of this information together with the average sulfur content of the charging stock, sediment of fuel, pounds of lime per barrel, and various other information are placed on a report which is compared to previous reports before filing. Any change in charging stock sulfur content is usually followed by a change in corrosion rate which is immediately adjusted by increasing or decreasing the amount of lime as the case may be.

SKIMMING PLANT

The same lime treatment is used on the crude tube stills, as is used on the cracking stills; the lime in this operation dropping out with the fuel in the evaporator. In addition to treating the crude with lime anhydrous ammonia is introduced into the evaporator above the liquid level of the evaporator. This ammonia is purchased in large cylinders which are placed on a specially designed rack making it possible for one man to change these heavy cylinders with very little trouble. The rate of ammonia is controlled by bubbling it up through a look-glass con-

(*Continued on page* 128)



The plunger rod of the lime pump is clamped to the piston rod of the steam pump charging oil to the unit, as designed by engineers of the Pure Oil Company

EDITORIALS

GASOLINE has started to market through pipe lines. The few projects in operation and those under construction leave no doubt as to the trend in gasoline transportation.

Just how gasoline goes to market may not have much influence on how it is made but it will have unmistakable influence on where it is made. Evidently the concerns now providing gasoline pipe lines are bent on retaining plants near crude oil production. Instead of transporting crude oil by pipe line and building refineries in centers of distribution, plants are to be kept in centers of crude oil production and gasoline will go to market at lowered transportation costs.

Unless a substantial part of each barrel of crude oil is left at refineries in the form of other products, the refining process must be gradually shifted toward the greatest possible output of gasoline. Pipe line transportation for gasoline will prove beneficial in proportion to the amount of each barrel of crude oil that is converted into gasoline.

The trend in refining will now be more severely turned toward converting all of a barrel of crude oil into gasoline, especially by those concerns which have decided upon pipe line transportation.

There is, of course, the future possibility of furnace distillate also going to market in pipe lines. But facilities for gasoline must be provided first and only a start has been made as yet.

GASOLINE offers this handicap to its manufacturer—its style can not be so changed as to make the existing supply obselete. End point, vapor characteristics and anti-knock rating may be altered but whatever gasoline existed before must be consumed.

The authorities of fashion can decree a longer skirt and immediately thousands of pieces of wearing apparel disappear—never to be worn again. The automobile manufacturer can change the design of his product and immediately hundreds of automobiles start for the junk heap, although they may still possess thousands of miles of good travel.

These trade stimuli are denied the maker of gasoline. Whatever he has created in the form of motor fuel remains to be used, regardless of what better qualities he may build into his product. Furthermore the surplus he held in his own tanks for the consumer never has a surplus of gasoline to discard. He may be converted to the use of some exceptional gasoline but he will elect to use it only when there is empty space in his automobile tank.

This condition applies to lubricating oil as well. No new and better lubricating oil ever prompted a 1000 automobile owners to discard any unused lubrication held in lubricating oil.

To offset this handicap is the singular circumstance of a gasoline consumption that continues to grow each year. It is a market created by another industry—the automobile industry. If the maker of gasoline can not send his product to the scrap heap before its usefulness has ended he can know that the amount of gasoline consumed this year will be more than that consumed last year. Perhaps it is not correct to set this as indefinite but it is the history of the gasoline market.

Petroleum is one of the few industries which in 1930 promises to see more of its product used than in 1929.

This all gets around to the fact that the refining of petroleum products is a distinctive business. There is nothing to be gained by striving to follow other industries. The market for gasoline grows steadily. Whatever of petroleum products is made must be used—otherwise it remains in the hands of the man who made it.

Repeatedly it has been said that there is no need for making more gasoline than the market will require.

NATURAL gasoline is headed toward a finished motor fuel. Plant methods and new equipment leave no doubt as to the progress in that direction. It is not far from an accomplishment at this time.

Economic conditions demand the change, for, as an adjunct to motor fuel, natural gasoline is subject to price fluctuations which are disastrous. As a fuel ready for the automobile natural gasoline will become a staple.

Along this, of course, will come the further development of other finished products from the natural gasoline plant. Bottled gas for household use and tank car gases for industrial uses already point the way.

It is a happy circumstance that these two work in conjunction. As the output of the natural gasoline plant heads toward a finished motor fuel, household and industrial gases become a necessity.

The Hydrogenation of Mineral Oils

By I. N. BEALL

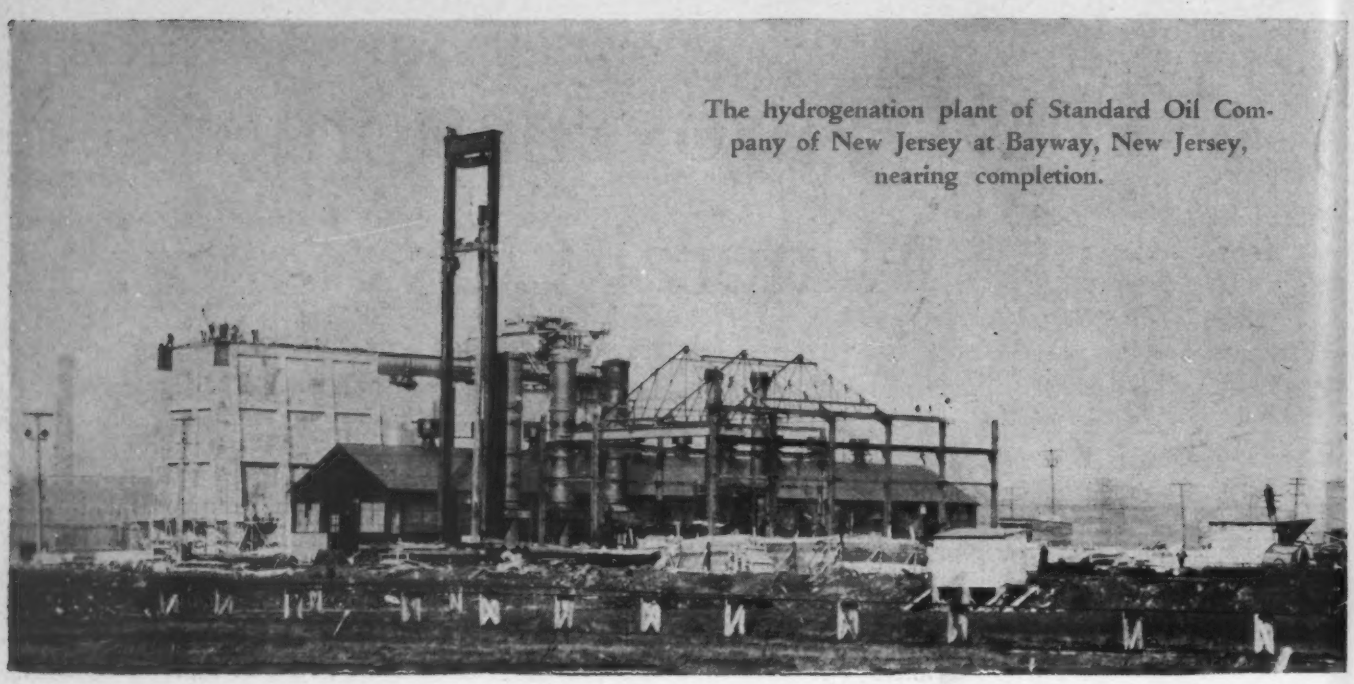
Because of the prevailing interest in the hydrogenation process, I. N. Beall, chemical engineer, was asked to interrupt his series of articles dealing with the practical application of technology to the manufacture of natural gasoline, to review the development and technology of this important achievement. Mr. Beall has been following the development of hydrogenation processes for the past several years along with his work on absorption, oxidation and desulphurization. He has promised a second article on this subject next month, after which the series on natural gasoline will be resumed.

IT would seem as though the long anticipated dream of the refinery chemist to produce 100 per cent of motor fuel from oil and other cracking stock is about to be commercially realized in the process of hydrogenation. The industry as a whole seems to stand upon the threshold of a new era in which changes of perhaps greater significance than that caused by the commercial application of cracking processes, portend. Certainly, at least the potential source of motor fuel will be extended to a degree hitherto unparalleled.

CRACKING AND HYDROGENATION

The term "cracking" is used to designate the thermal decomposition that takes place when a heavier hydrocarbon oil breaks down into a lighter and more volatile oil. Such reactions are always accompanied by the formation of both fixed gas and carbon. Strictly speaking decomposition and synthesis both take place as both lighter and heavier products are formed by the operation. The more severe the temperature conditions imposed upon oil undergoing thermal decomposition the wider is the spread between the light and heavy products until finally, if carried sufficiently far, only hydrogen and carbon remain. Thus it is seen that temperature alone can produce changes determinable only by its degree of severity. An almost infinite number of changes can be made in the nature of an oil by variations of temperature. Pressure also exerts a profound influence on the nature of a hydrocarbon material undergoing thermal change. Pressure exists in two form as far as concerns process for the cracking of oils, namely internally generated and externally generated.

Internally generated pressure is distinguished from externally generated pressure by the fact that it is produced from thermal effects upon the constituents of a closed system, an example of which is pressure distillation as in the Burton and other similar processes, whereas external pressure is independent of temperature and supplied by such mechanical means as pumps or compressors. It is necessary to distinguish between the two types of pressure for purposes of discourse, as the effects are entirely different. Mechanically applied pressure favors synthesis in a chemically active system. Its chief use in cracking processes is to regard the formation of those gases which are lighter than motor fuel. In so doing the formation of heavier ends is also retarded which results in the production of more intermediate products, such as motor fuel, the desire being to get such an optimum combination of temperature and pressure as will give the greatest yields with the least formation of tars, coke and non-condensible gas. Strangely enough hydrogen is always found in the so-called non-condensible gases from cracking operations, the amount varying with the pressure, temperature, time and nature of the materials within the system. For a given set of conditions all others remaining the same, an increase in pressure will decrease the amount of hydrogen generated. Had the cracking still gases been recirculated and the pressure held sufficiently high the total amount of hydrogen formed over a period would have been less. This fact has been variously noted and industrially applied, although all of the benefits derived cannot be attributed to the action of uncombined hydrogen. Hydrogenation in a broader sense includes its addition in the combined form as well as in the free state. For example, the chemical combination of ethylene C_2H_4 with acetylene C_2H_2 to form C_2H_6 might be considered



The hydrogenation plant of Standard Oil Company of New Jersey at Bayway, New Jersey, nearing completion.

as hydrogenation of the acetylene as the final compound contains a greater proportion of hydrogen than the original.

SOURCES OF HYDROGEN SUPPLY

Hydrogen in its free form may be said not to exist except in minute quantities in the atmosphere and the earth's crust. Because of its great chemical activity it has already combined with other elements and substances to form water hydrocarbons, vegetable and animal life. Many substances contain hydrogen in combined form. Hydrogen's greatest elemental affinities are oxygen and carbon with which it combines to form respectively water and hydrocarbon. Nature uses carbon dioxide and water as raw material for the manuafcture of plant life, through which medium in the course of time most of the coal and petroleum hydrocarbons are formed. It is of interest here to note the reversible reaction between carbon dioxide and hydrogen $CO_2 + 4H_2 \rightleftharpoons CH_4 - 2\ H_2O$ which takes place at 392-752° F. in the presence of suitable catalysts.

The great potential sources of cheap commercial hydrogen are water and natural gas. Other lesser sources of supply are cracking still gases, water, gas from the interaction of steam and coke in accordance with the equations $C + H_2O = CO + H_2$ and $CO + H_2O = CO_2 + H_2$. Water gas consists essentially of equal parts of hydrogen and carbon monoxide with small percentages of carbon dioxide, nitrogen, pariffin gases, water, vapor and sulfur compounds. It would seem as though a gas of the nature of water gas would be suitable for the hydrogenation of heavy mineral oils as carbon monoxide of itself exerts a favorable effect upon both the quality and yield of gasoline produced by pyrogenesis under pressure. The presence of hydrogen would further improve both yield and quality. Methane, the chief hydrocarbon constituent of natural gas, interacts with steam for the production of hydrogen by a reversal of reactions previously discussed. These reactions are not limited to methane, as they are of general application to the hydrocarbon series other than aromatic and naphthene. It is thought that under more severe conditions both aromatics and naphthenes may be similarly acted upon.

Of all the proposed processes for the cheap commercial generation of hydrogen from water, that proposed by Berguis seems the most practical. This process as stated depends upon the reaction between finely divided metallic iron, such as might be produced from a reduction of the oxide at low temperatures, and liquid water at a maximum temperature of 650° F. and a pressure of 2500 to 2550 pounds per square inch. A similar reaction is stated to take place between coke and liquid water in the presence of small amounts of

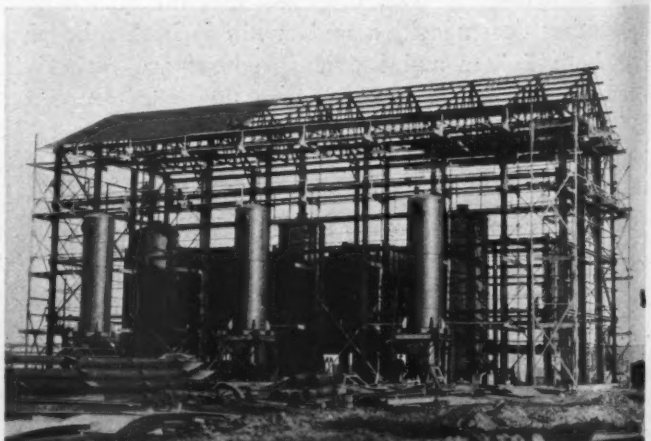
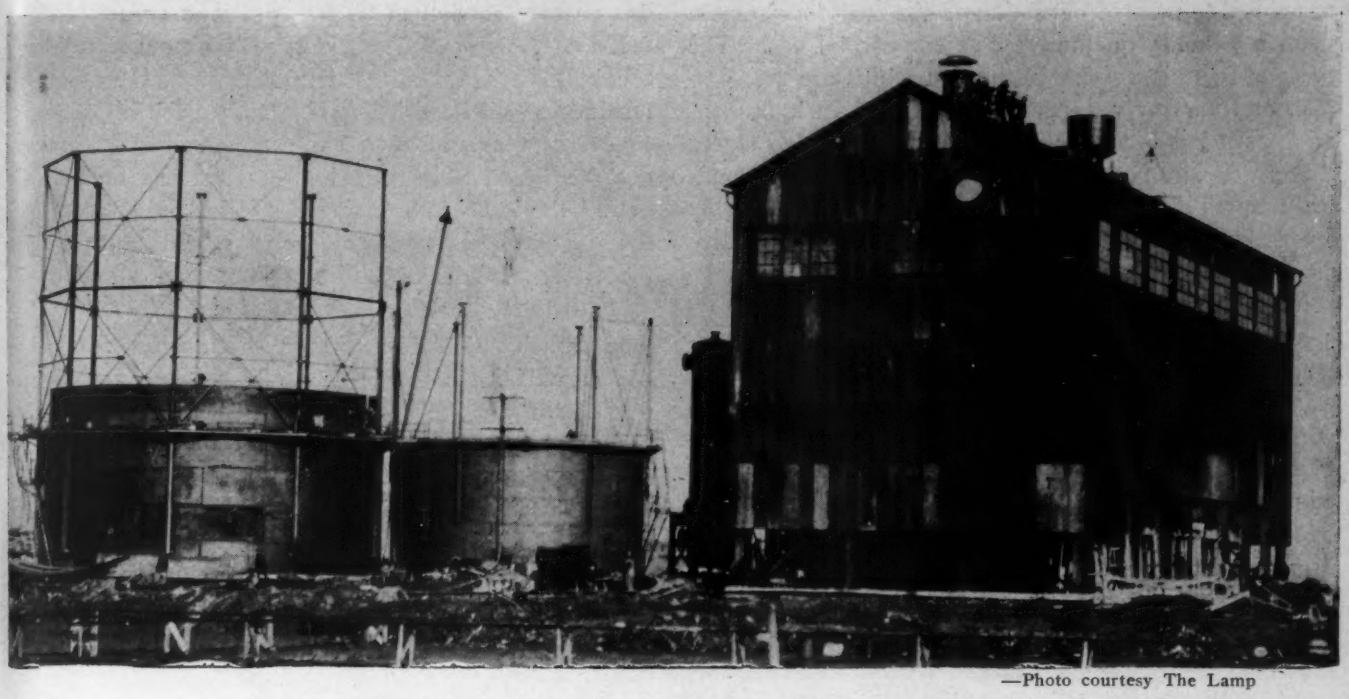


Photo Courtesy The Lamp

Hydrogen manufacturing unit. The gas building under construction.



—Photo courtesy The Lamp

reaction promoter the reaction here being $C + 2H_2O = CO_2 + 2H_2$. It would appear as though a combination of the two reactions might be of value, since the necessity of regenerating the iron from its oxide might be avoided.

The great advantage of such a process as above mentioned as far as the hydrogenation of mineral oils is concerned, lies in the fact that it is only necessary to pump liquid water in order to produce the hydrogen under sufficient pressure for all purposes necessary in the subsequent step. When it is considered that 100 pounds of water contains 11.1 pounds of hydrogen and that one pound of hydrogen occupies 176 cubic feet at atmospheric pressure, the advantage of such a system is obvious over that of one in which compressors must be used to boost the pressure. It is claimed also that the hydrogen from this process is of an exceptional degree of purity, which may or may not be of advantage as far the hydrogenation of mineral oils is concerned. For the hydrogenation of certain types of heavy residuums there is a possible advantage in pure hydrogen.

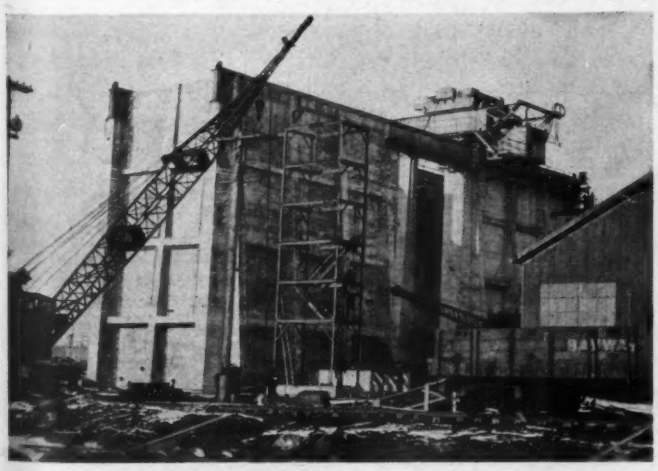


Photo Courtesy The Lamp

Heavily constructed concrete stalls enclosing the reaction chamber where hydrogenation takes place. Note the large traveling crane at the top of the structure.

The possibility of obtaining hydrogen by the pyrolitic decomposition of natural gas has received and is still receiving considerable attention by research investigators. Primarily investigations along this line had for their aim better means than existed for the production of carbon black. The solution has been attended with practical difficulties, such as materials to withstand the necessary high temperatures, and clogging of apparatus due to the formation of coky carbon. Large quantities of heat are required for the decomposition of hydrocarbon into its elemental constituents, carbon and hydrogen. Temperatures in the neighborhood of 2700° F. are said to be necessary for the approximate dissociation of methane into carbon and hydrogen, although the writer has noted an excellent degree of dissociation at 600° F. in the presence of metallic iron and under a pressure in excess of 20 atmospheres. Dissociation is favored by the presence of oxygen in the gaseous mixture undergoing treatment.

Another reaction also noted was that between CO_2 and hydrocarbon gas wherein at temperatures of 1800-2200° F. the reactions were for example $CO_2 + CH_4 \leftarrow 2C + 2H_2O$ and $CO_2 + CH_4 \leftarrow 2CO + 2H_2$. Under such conditions iron is converted into the magnetic oxide.

CHEMISTRY OF HYDROGENATION

While chemistry for the production of hydrogen presents opportunities for quantative methods based upon accurate theoretical and experimental data, chemistry

as applied to the hydrogenation of oils must long remain upon a general, qualitative and empirical basis. The reasons for this are many, chief of which are the complex and varying natures of petroleum. In hydrogenation as it has been in cracking, it may be safely stated that practically nothing is known of the specific chemical natures of the raw charging stock and considerably less is known of the individual structure of the hydrocarbons resulting after processing. However, the refiner is more concerned with certain practical characteristics in the finished product and these characteristics are dependent upon the relative proportion of classes of constituents rather than upon individual constituents. It is doubtful that under the present conditions of the refining industry a more specific knowledge of raw and finished material would be of value. Fortunately the laws governing the changes that occur in an undergoing heat and pressure processing are sufficiently general to be applied.

These laws are those of physical chemistry and the principles are based upon thermodynamics. Crude oils are broadly classified as paraffin, naphthene, asphalt and hybrid or mixed base. This classification is based upon predominating characteristics and there is much overlap. Cracked oils contain other series of hydrocarbon than those in the virgin state, and include oils that fall within the above classifications, also those that may be classified as unsaturated base and aromatic base. Other classifications may exist, the chemistry of which is as yet obscure. Hydrogenation adds a new series to the list which may be classified as the hydro-aromatic which is closely related to the naphthenes and aromatics.

EFFECT OF TEMPERATURE

The effect of temperature on hydrocarbon material is two-fold, namely: first, it causes an increase in chemical activity up to a certain degree of heat and, secondly, decomposition into simpler and more stable constituents. The two results which at first glance may seem incompatible, prove on further inspection to be as anticipated. When a thermally sensitive material such as heavy oil hydrocarbon is heated, changes occur with each increment of heat, the products at any time are those having sufficient bonding energy to withstand the disrupting influence of temperature. The substances most nearly approaching the elemental form (carbon, hydrogen) are the most stable. This is best illustrated by stating that no presently attainable amount of heat can further decompose either elemental hydrogen or carbon. Starting at one end with the simplest hydorcarbon CH_4, methane, the hydrocarbons of the chemically saturated series C_nH_{2n+2} are progressively less thermo-stable, due allowance made for the isomeric forms. In the other end of the line it is found that the series C_nH_{2n-6} is also extremely thermo-stable, an example of which is benzene, C_6H_6. Very little is known chemically other than in an emperical way of those series of hydrocarbons having a less ratio of hydrogen to carbon than C_nH_{2n-6}, yet is is an established fact that the so-called cracking still cokes and residues are hydrocarbons rather than carbon and that those residues which have been subjected to the highest extremes of temperature are the ones poorest in hydrogen. In heat treatment of hydrocarbon as elsewhere in nature the law of the survival of the fittest seems to hold. This in no way should be construed to mean that the fittest are the most desirable, as one standard is that of nature and the other is arbitrary.

Inasmuch as hydrogenation must supply an otherwise deficiency in the original material so far as the production of motor fuel by pyrolysis is concerned the logical sources of supply stock are heavy crudes and crude residuums. It must not be understood, however, that hydrogenation in its various forms of applications must be limited to residuum oils, as every stock suitable for cracking purposes for the production of motor fuel will be suitable for hydrogenation, although under certain conditions it may be found more economical to crack.

STABILITY OF HYDROCARBONS

The question that might naturally arise from the preceeding discussion is what is the nature of those hydrocarbons falling within the range of motor fuel and what are their characteristics in their most stable form? The answer is that they are of the ring series, which includes among many others, benzene, tolnene, xylene and the hydro-aromatics. The anti-knock value of such substances is already well known, the series is characterized by their relatively great volatility as compared to their low Baume gravity. In a weight basis their power output on detonation in an internal combustion engine differs but little from that of an ordinary motor gasoline with the exception of smoother operation, but on a volume or gallonage basis the power is much greater as there are more pounds per gallon.

The series of hydrocarbons next in order of stability towards temperature are the naphthenes. These also

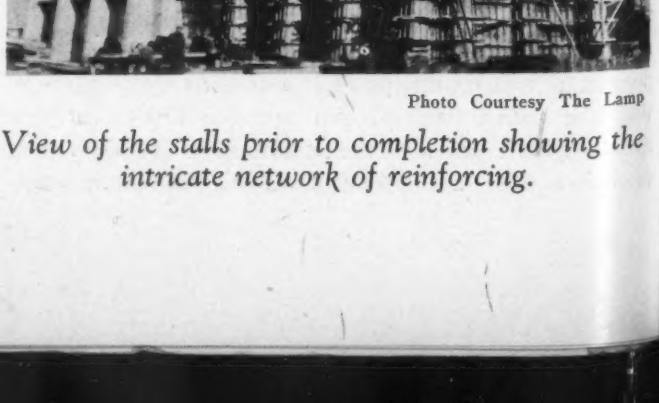
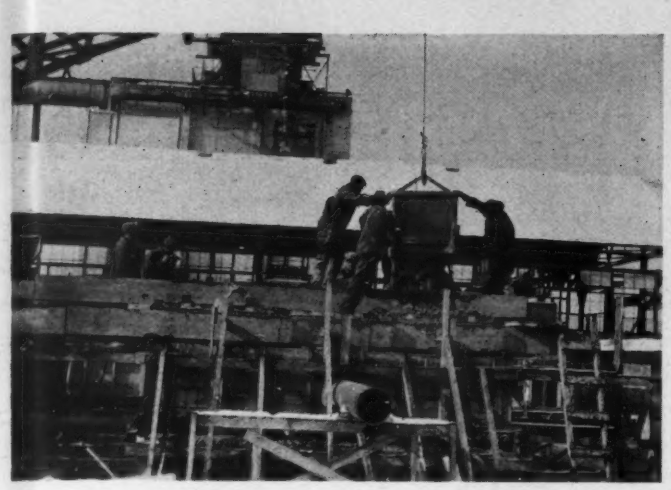


Photo Courtesy The Lamp

View of the stalls prior to completion showing the intricate network of reinforcing.



—Photo Courtesy The Lamp

Pouring some of the 4700 cubic yards of concrete that went into the Bayway, New Jersey, hydrogenation unit

are ring compounds of what is known as the chemically saturated type, which means they have the maximum attainable hydrogen in chemical combination for that series. These also have excellent anti-knock properties, but not as much experimental data is available concerning them. It is, however, a matter of general observation that the straight run gasoline from the naphthene base crude is an excellent motor fuel and has a higher anti-knock rating than the straight run gasoline from paraffin base crudes.

The next in stability of the major series of hydrocarbons that constitute motor fuel are the olefins, or what is known as the chemically unsaturated. Cracked gasoline contains a large proportion of these hydrocarbons, loosely designated as "unsaturation" by the sulfuric acid test. These compounds of hydrocarbon are chemically active and capable of combining directly with a great many other substances, such as oxygen, halogens, hydrogen, with themselves, or with other hydrocarbons. Under the effect of external energy such as temperature and pressure and in the presence of hydrogen (vapor-phase) the tendency is strongly toward the naphthene, aromatic and hydro-aromatic series as a maximum of stability before the gasification stage. The unsaturates stand intermediate between the naphthenes and paraffins as anti-detonants.

ACETYLENES VINYLS AND DIOLEFINS

The chemical activity of these groups is very great as they are the most deficient in hydrogen of the identified series. These compounds have a marked ability to combine with themselves or similar compounds to form polymers and condensation products, such as gum in gasoline, sludge in absorption oil, and tar and coke in cracking stills. Their ability to combine with hydrogen is remarkable and the fact that hydrogenation to a major extent precludes the possibility of their more than momentary existence within the reaction zone helps to make hydrogenation superior to cracking for the production of motor fuel. Most of the coking troubles in cracking systems are due to the formation and subsequent polymerization of compounds of this nature. Dehydrogenation after polymerization causes progressively heavier tars to form until the hard coke stage is reached. Even in this stage the product, coke, still contains small percentages of hydrogen. Under correct conditions of phase temperature time and pressure these compounds form naphthenes, and ring compounds.

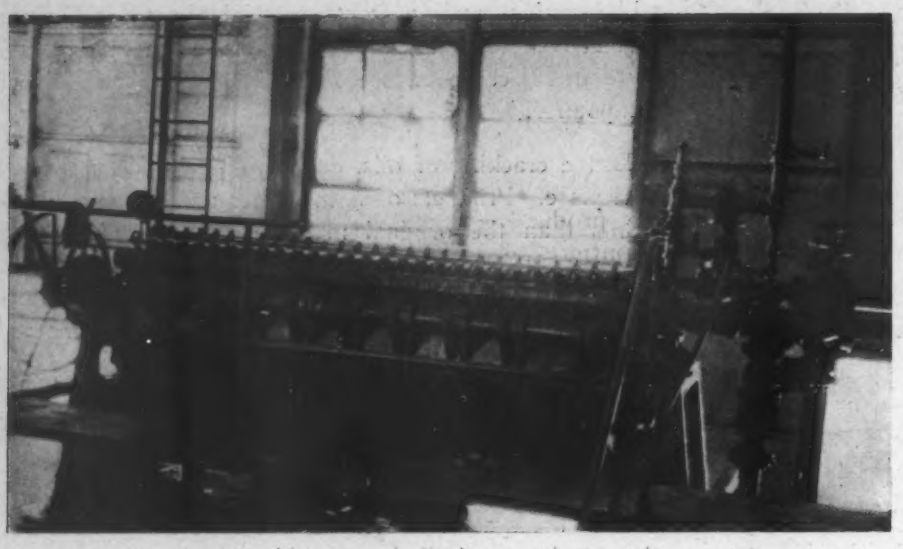
In the cracking of oils, decomposition and synthesis take place. Products of both higher and lower boiling points than the original material are formed. The range extending from the lowest, namely hydrogen and naphthenes, to the highest, which is carbon. No cracking process can produce 100 per cent by weight of motor fuel because of this formation of lighter uncondensible gases, on one side, and tars and coke on the other. Such reactions must of themselves proceed to equilibrium in which all stages from gas to solid are present. It is here that hydrogen comes in to fill the need, its addition to the system under pressure forces a portion of the fixed gases back into combination in the form of liquid fuel. The tendency at lower temperatures and higher pressure is the formation of saturated or paraffin series from the unsaturates, on further temperature increase the naphthenes, and finally the aromatics.

Vapor phase and high temperature favors the formation of the fixed gases, aromatics and other compounds of a relatively great proportion of carbon to hydrogen. An excess of hydrogen naturally produces a degree of vapor phase in proportion to its excess even under the high pressures where the vapor density would theoretically exceed the liquid density for the existing temperature. Therefore, under conditions of high temperature and pressure those hydrocarbons that would fall beyond the range of liquid fuel into the classification of tars and coke would be acted upon physically and chemically by hydrogen and driven toward an intermediate equilibrium in which the true aromatics, hydro-aromatics and naphthenes would predominate. A substance in the vapor phase has the greatest energy content as energy is necessary to convert from the liquid to the vapor phase. Those substances that withstand the greatest amount of energy will survive decomposition and those hydrocarbons that cannot survive the conditions will change to the more stable forms. The destructive distillation or coking of coals produces benzene, xylene, tolnene, phenol, tars, etc., because these are the only materials that can exist under the high temperatures necessary. In the hydrogenation of coal under high pressure and comparatively low temperature the hydrogen-poor hydrocarbons of the coal become richer in hydrogen and the

(*Continued on page* 128)

By JOE E. MEYER

An Investigation of



Contact Clay Filter Press, Deepwater Refineries, Houston

THE decolorizing effect of acid-treated bentonite has been the subject of various theories advanced to explain the phenomena. The conclusions of investigators indicate that the action may involve adsorption, filtration, possible chemical reaction, and catalysis. The observed phenomena attendant with the clarifying of oil by means of acid-treated otaylite seem to point that the action of the clay on an oil is an adsorption; that this adsorption is, in general, not reversible; that immediately after adsorption the chemical nature of the adsorbed substances changes, the change being perhaps a polymerization; that due to the irreversible nature of the adsorption, the adsorption proceeds rapidly and often becomes almost instantaneous if the clay is very finely divided and the oil reaches all the surfaces readily. The efficiency test should indicate in some measure the adsorptive value of the clay, but this is rather difficult as the adsorption of detrimental substances in each oil is really specific since it varies with the nature of both adsorbed material and adsorbent in which the adsorption takes place. However, when all other factors remain the same, or substantially the same, the amount of adsorption is proportional to the surface of the adsorbent, and to the concentration of the material adsorbed.

HEAT TEST

Another test which shows adsorptive values that roughly parallel the values arrived at by the method for determining the ratio of decolorizing values is of interest. Evolution of heat parallels adsorption especially if polymerization takes place; this is only a roughly parallel relation, but is sufficiently accurate for most purposes. A standard solution of pinene is made up using petroleum ether or ethyl ether as a solvent. Samples (of the same weight) of different decolorizing clays are added to equal volumes of the solution and agitated. The temperature rise is noted. In general, the clay which gives the highest temperature rise has the greates decolorizing value. The pinene is diluted to moderate the action. This test is not considered as valuable in determining the decolorizing value of clay as are tests which approximate plant practice, but is of interest for comparative purposes.

The finished clay may be used for many purposes. Generally speaking, it may be said that adsorbents are used in order to make more valuable, by increasing their useful properties, petroleum products undergoing such treatment. Specifically, adsorbents decolorize the oil by separating solid suspended, colloidal and dissolved impurities such as small particles of coke, finely divided and colloidal carbon, complex tarry compounds of high molecular weight, dissolved coloring matter, as well as traces of suspended alkali, acid and moisture. Paraffine hydrocarbons are also removed to a limited degree by some adsorbents. The removal of wax is of particular importance in the manufacture of lubricating oils, the market value of the finished product being increased by the removal of the paraffines and the attendant lowering of the cold test.

The products of petroleum to be treated fall into three classes—light oils, lubricating oils, and waxes. Destructive, vacuum, or steam distillation may be used to produce these products. Destructive distillation causes cracking with the resultant high proportion of higher hydrocarbons, dark color, and added difficulties in refining. The other methods of distillation are considered better for producing lubricating oils. Some oils produced from certain paraffin-base crudes are ready for the market after distillation without further processing, but fractions distilled from asphalt oils or oils that have undergone pyrolytic decomposition (cracking) are usually

Treated Clays

THIS is the second and concluding article written by Joe E. Meyer, dealing with treated clays and their utilization in contact filtration processes by the refining industry.

treated with sulphuric acid. If the oil has not been acid-treated, the treated bentonite is called upon to remove carbon (finely divided or colloidal), complex tarry compounds of high molecular weight, and dissolved coloring matter. Sulphonates, esters, free acid, and the impurities listed above may be contained in an oil treated with sulphuric acid and washed with water, and an oil which has been acid-treated and neutralized with caustic may contain the same substances with alkalies being present instead of free acid as the only difference. Some refiners prefer untreated bentonite to effect neutralization of acid-treated oils, and for treating gasoline. Untreated bentonite is cheaper than acid-treated bentonite, but this initial price advantage is more than offset by the far superior decolorizing value of acid treated bentonite.

USES WITH LIGHT OILS

In the refining of light oils (gasoline, kerosene, and other light oils), adsorbents are used mainly only insofar as it is necessary either to improve the color or remove such objectionable sulphur compounds as hinder the ready marketing of the product. The treatment of light oils with fine clay is a practice extensively used by refiners in California, and to a lesser degree by refiners elsewhere. In the refining of pressure still distillates and such distillates as result from the processing of crude oils from California and Mexico, it is found advisable to follow the chemical treatment by treatment with an adsorbent. The use of an adsorbent in treating oils of this type improve the color and odor very appreciably, and if the oils are given sulphuric acid treatment without subsequent neutralization, deacidifies the acid oil in addition to improving the odor and color. An acid-treated clay such as otaylite is particularly adaptable for this use. Absorption oils, transformer oils, long-time burning oils, and other oils of a similar type, are adsorbent treated following the chemical treatment. In the case of absorption oils, the removal of compounds responsible for emulsification is very important; in transformer oils, removal of corrosion and slude forming constituents, moisture, finely divided and colloidal carbon and other undesireable constituents which lower the dielectric properties of the oil is highly essential; and in long-time burning oils, the removal of certain compounds resulting from the acid treatment and believed to be detrimental to the burning qualities is necessary to produce a satisfactory product. Acid-treated montmorillonite (otaylite) is particularly efficacious in treating oils of this type. It is also an excellent adsorbent for decolorizing these oils.

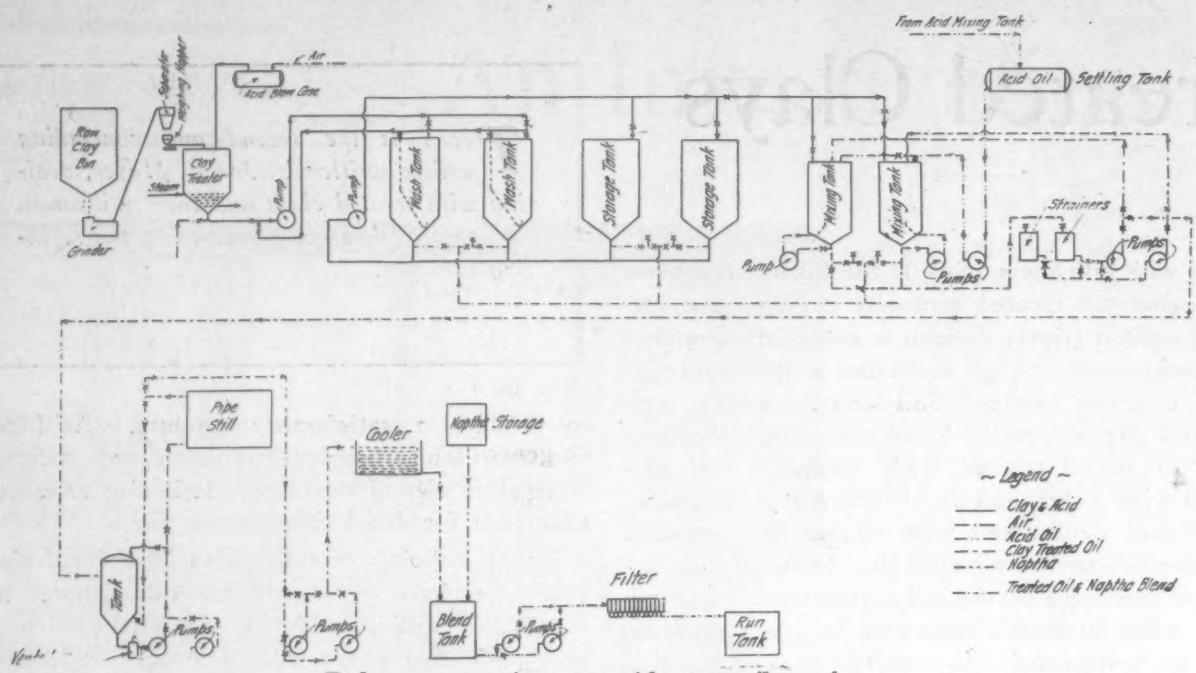
In the refining of lubricating oils (neutrals and bright stocks), adsorbents are called upon to remove quite a number of diverse substances from oils produced from many different types of crude oil, and by a variety of distillation methods. Excluding some Pennsylvania oils, which are given no acid treatment, the majority of lubricating oils produced are first given a chemical treatment, followed by a clay treatment. The "contact process" (now generally recognized as being the most effective and oconomical method of utilizing adsorbents to remove deleterious substances from oils), employs the adsorbent in a finely divided state, the adsorbent usually replacing chemical neutralization, as well as clarifying the color, improving the demulsibility, removing the carbon (finely divided or colloidal), complex tarry compounds, sulphonates, and esters. Acid-treated bentonites are far superior to fuller's earth and the usual type of adsorptive clays in the treatment of lubricating oils.

Adsorbents are employed in the refining of paraffin wax to decolorize the wax. Acid-treated montmorillonite (otaylite) is a very superior adsorbent for clarifying the color of paraffin wax.

In the refining of vegetable and animal oils and fats, adsorbents are used to decolorize and remove objectionable odor. Acid-treated bentonite has been shown to be superior to either English or Florida fuller's earth in bleaching and clarifying crude brown packing-house lard (Spence, H. S., Bentonite: Canada Dept. Mines, Rept. 626, 1924, 35 pp.)

The finished clay is in a very finely divided condition. Percolation methods are ordinarily used for the treatment of oils with fuller's earth but because of the great resistance to the flow of oil offered by a compact body of treated clay, the method used in treating oils with an adsorbent of this type is the so-called "contact process." Processing by this method is approximately as follows:

The oil after acid treatment in the agitators, but without neutralization of any sort, is pumped to the



Pulp process of contact filtration flow chart

From American Petroleum Refining, By H. S. Bell, C. E.

open top agitation tanks in the filter house; it is then agitated with mechanical stirrers and the proper proportion of clay added, the quantity being dependent upon the nature of the oil and the degree of decolorization desired. Agitation by mechanical methods is preferable since agitation with air at the temperatures attained in the process tend to promote oxidation of the oil and a consequent "off-color" product.

Heat is then applied by means of steam coils in the agitation tank, and by circulation through an exchanger, until a temperature ranging from 250° to 350° F. has been reached. The optimum temperature is determined by the degree of heat at which maximum decolorizing and deacidifying efficiency of the adsorbent is obtained.

In contact filtration the clay may be added wet (in a mudded condition) to petroleum products of high boiling point, but "dry" clay has the greater efficiency when used to treat gasoline. The use of the mudded clay adsorbent in treating lubricating oils utilizes the water in the clay to advantage as follows:

1. The steam evolved on heating assists in agitating the clay and oil.

2. The steam produced forms a protective blanket over the surface of the oil and decreases the liability to oxidation by contact with the air.

In using mudded clay in the contact process the oil is held at the optimum temperature for obtaining the greatest efficiency from the adsorbent until steam is no longer emitted, and then for 15 minutes in addition, agitation being continued meanwhile. The oil is filtered while hot through an ordinary leaf-type filter to remove the suspended clay.

The filter-press cake retains some oil. This cake is usually best worked for its contained oil by washing with a light distillate and drying right in the filter-press. The clay may be used for treating several batches of gasoline or light oils without rejuvenation, but for heavy oils it must be discarded after one application. The dry cake from the filter press may be rejuvenated by "burning" to remove matter of a carbonaceous nature. The burning destroys practically all of the adsorbed material and leaves the clay ready for use again. The first burning may reduce the efficiency from four to 2.5; after this initial reduction there is very little loss in efficiency and the clay may be rejuvenated several times. In some cases it is more economical to use new clay.

The material adsorbed from oils and held in the clay (complex tarry compounds, polymerized unsaturates, and similar chemical compounds) may be extracted by treatment with some solvent or solvents such as benzol, benzol-alcohol, or gasoline-acetone. When the material adsorbed from oils by the adsorptive action of acid-treated clay is extracted with some dissolving medium and the solvent distilled off, the residuum has a very disagreeable odor and was found to contain distinctly unsaturated compounds. Compounds of sulphur and nitrogen are also present. Further investigation of the properties and possibilities of this tar was not made.

A modification of the method of contacting previ-

ously outlined is used in some refineries and differs essentially only in the manner of removing the clay from the oil by filtering. This modification is essentially as follows:

EFFECT ON LUBRICATING OILS

After agitation in the open top agitation tanks is discontinued a portion of the clay is allowed to settle out. The hot oil containing some suspended clay is pumped out through a swing line to a vertical type of filter, provided at the bottom with a blanket-covered perforated drainage plate to hold the clay, which removes the suspended adsorbent from the oil. When the filter has collected sufficient clay to impair its efficiency, it is blown with air, washed with a light distillate, again blown, and then dumped. The used clay is subject to the same limitations in re-use as in the method of contact processing previously described, i. e., it may be used for treating several batches of gasoline or light oils without rejuvenating, but for heavy oils must be rejuvenated before re-use after one application.

The lubricating oils produced in contact processing by the use of acid-treated adsorbents of the subbentonite-type (montmorillonite) show exceptionally good tests in regard to emulsion, carbon residue, neutralization number, corrosion, color, and moisture.

This is of especial import in the treating of lubricating oils from certain mixed-base and asphalt-base crude oils that present difficulties in the attainment of good emulsion and neutralization number tests by other means of treatment. California oils which because of their naphthenic acid content render meeting of the neutralization number specifications troublesome by some methods of treatment are brought to specification in this respect without difficulty when contact processed with acid-treated adsorbents of the subbentonite-type.

A good emulsion, carbon residue, corrosion, and neutralization number test indicate, respectively; the removal in refining of substances (probably salts of naphthenic acids) which produce emulsification with water; the extent of refinement of the lubricant and the residual carbon content of the oil when used in an internal combustion engine, (the interpretation of the test is a matter of considerable disagreement among chemists and lubrication engineers and the author's statement is intended as a generalization only, and not as inferring that the carbon residue test is an absolute index of an oil's ability to *withstand heat,* i. e., its resistance to decomposition, abnormal loss in viscosity and burning to hard carbon.); removal of deleterious acids and sulphur and their compounds to which the staining or corrosion of polished copper by oil is attributable and by which its corrosive action on other metals is indicated; and the freedom of the oil from mineral acids in harmful quantities.

The value of the improvement in color of an oil effected by treating it with any comminuted adsorbent such as fuller's earth or an acid-treated clay is a moot question. Suffice it to say, color as such cannot be regarded seriously from a purely technical standpoint, never-the-less, a color standard makes mandatory care in refining, and insures careful processing from the crude oil to the finished product if oils of good color are produced. Thus, in a way, color is indicial of the degree of refinement. This may be illustrated, for example, in the case of an oil that has received acid treatment. Acid treatment is generant of certain reactions which produce sulpho-compounds (possibly di-alkyl sulfides; di-sulfides; thiophenes; or thiophanes) when the finished oil is heated. These compounds decompose quickly and seriously impair the efficiency of the oil if they are not removed. As a result, "filtering" treatment with adsorbents is considered the final necessary step in making good neutrals and bright stocks. The effect of an efficient "filtering" medium is greatly improved color as well as the removal of substances known to be inimical to the efficiency of the oil in service.

OBJECTIVE

In this investigation of claylike minerals the objective was a suitable raw material or materials which would on processing yield an efficient adsorbing medium for use in the refinement of petroluem products and which would be feasible from an economic standpoint for large scale utilization in the industry. In the course of the investigation some 300 different claylike substances were examined, and if of a promising nature, processed and tested for relative efficiency.

There is practically no way in which the value of a clay (for the purpose investigated) may be foretold except by actual test. However, the clays found suitable were observed to have certain characteristics in common that are indicative of their general adaptability and this fact is of unqualified advantage in the preliminary examination of claylike materials for promising adsorbents. They practically all show a roughly conchoidal fracture; all demonstrate a shrinking tendency on drying, developing cracks in all directions; most of them disintegrate with increase in volume when placed in water, slacking to fine particles or flakes on standing for several hours; extreme plasticity is manifested in all cases; and their action as so-called "emulsifying agents" ("An emulsifying agent is therefore a substance which goes into the interface (oil-water) and produces a film having satisfactory physical properties." Bancroft, W. D., Applied Colloid Chemistry. 1921, 345 pp...), is pronounced. These properties indicate the

colloidal nature of the clay, and since the most efficient of the clays treated were, in the raw state, colloidal in nature, it would seem to be one requisite of a raw clay which will make a good treating clay after chemical treatment, although it does not by any means insure that the clay will, with processing, turn out to be an efficient adsorption medium. The chemical composition and geological classification are of small aid in determining the utility of a clay for treating purposes.

The subbentonites (bentonites in which the alumina is readily attacked by the sulphuric acid in treatment) in all cases produced adsorbents the best suited for effecting the decolorization of light oils, lubricating oils, and wax. The Wyoming-type bentonites (containing alumina resistant to sulphuric acid) have an objectionable amount of free acid after being treated, are slow in drying, and form a tenacious plastic mass which if dried forms a hard cake—in contradistinction to the subbentonites which under the same treatment resemble silica gel when dehydrated, filter without difficulty, retain very little free acid, and on drying are easily pulverable. The experimental data on the bentonites examined are altogether indicatory of the definitive superiority of the subbentonites as adsorbents for the refining of petroleum products.

ADVANTAGES OF TREATED CLAY

Other clays were found, which, by special treatment, would yield very good results when used to treat petroleum products. They were, however, because of the special treatment necessary and the cost incident with such processing and their lesser efficiency, dismissed from consideration as not being practicable on a commercial scale. Halloysite (subbentonite, California) have good results on treatment and showed an efficiency (as compared with a good fuller's earth) of from three to four. Death Valley Clay (subbentonite, Inyo County, California), known as shoshonite and amargosite, gave about the same values. Several unnamed clays (subbentonite-type) from Nevada showed efficiencies of from 2.5 to three.

Treatment with sulphuric acid gave the best results in treating of the various acids used for this purpose. Each clay was an individual problem, never-the-less, in respect to the optimum strength and concentration to use. The possibilities of each individual clay were readily ascertained by a standard preliminary examination, and if the results warranted further investigation the clay was given additional treatment under varying conditions of concentration and temperature.

Montmorillonite (otaylite) when treated as described in this paper, will yield a clay having an efficiency, i. e., decolorizing value, of from four to six, depending upon the care exercised in treatment. This interpreted into practical values, means that only from one-fourth to one-sixth of the amount (by weight) of treated otaylite is needed to clarify an oil to a certain color, as would be required if the best fuller's was used.

A good treated clay has a high decolorization value and consequently only a small amount need be used to accomplish good results. This means a very small loss of oil in the clay itself, and, that a very small cost is incurred in the recovery of the oil and used clay, as compared with that incurred when a greater bulk of material, such as fuller's earth, is used. The time required for decolorization with an acid-treated clay, using the so-called "contact process," is only a small fraction of that found necessary in percolation methods using granular fuller's earth, and, may be controlled. The color from any one batch is uniform throughout, and may be shaded and controlled by varying the amount of treated clay applied. The amount necessary to obtain a certain color may be determined in the laboratory, and the result duplicated in plant practice. Less acid is required for treating oils than is normally used for products to be percolated through fuller's earth, and neutralization after acid treatment is accomplished very efficiently by treated clay, thus doing away entirely with the introduction of large amounts of water in the oil, and of the resultant danger of forming emulsions. The physical tests of the products produced by processing with acid-treated clay are excellent, and the apparatus and operations necessary to produce these products are very simple; of reasonable cost (initial cost of installation, as compared with that of a percolation plant, is about one-tenth, and operation labor cost is reduced in the case of a "contact system"); and, due to simplicity of design and operation of a "contact system," are easily controlled. The use of treated clays in the relubricating oils, has received a great impetus in the last few years, and processes involving the use of bentonite, California) gave good results on treatment greater bulk of material, such as fuller's earth, is used.

Absorption plant of United Carbon Company in Richland Parish, near Alto, Louisiana

Richland Field Absorption Plant

By A. J. MACKINNON

Superintendent, Gasoline Department, United Carbon Company, Monroe, Louisiana

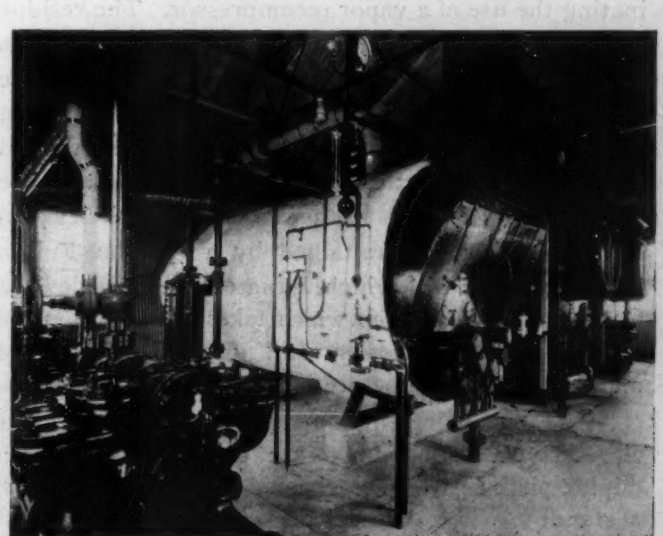
ANOTHER step in the development of the Richland field in Richland Parish, Louisiana, was made when United Carbon Company recently completed the construction of an absorption plant to treat gas which is piped to St. Louis, Birmingham and surrounding territory and points in Arkansas and East Texas.

The plant has a capacity of 30 million cubic feet of gas daily at 400 pounds pressure, with provision for its increase to 50 million cubic feet by the additional installation of two absorbers. Oil and gas headers are provided with connections which will enable the tie-in of this additional equipment to be made with a plant shut down of a few hours.

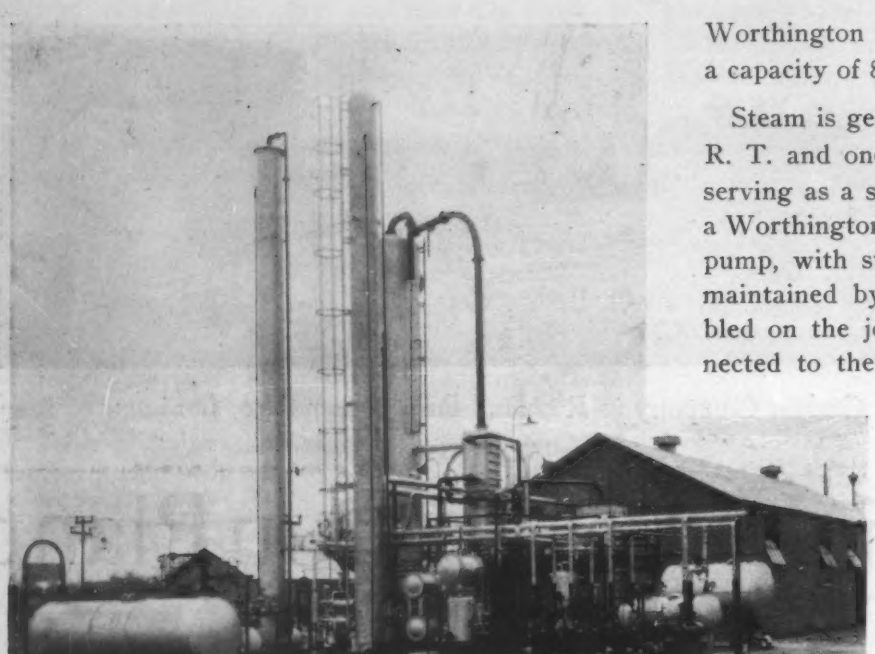
Three 48-inch x 38-foot Southwestern bubble type absorbers, a Southwestern Type 85 distillation unit, a Type P rectifying column of the same make, a Flour redwood cooling tower and some of the pumping units, comprise the new equipment purchased for this plant. All buildings, tankage, boilers, the smaller pumps and most of the fittings were salvaged from other plants previously dismantled by the company.

Gas from the gathering lines passes through a centrifugal scrubber into the absorbers at 400 pounds pressure. Outlet gas passes through another scrubber equipped with an automatic oil trap, thence through a meter setting of four meter runs which measure the gas before delivery to the different pipe lines for shipment.

Oil level in the absorbers is maintained by Chaplin Fulton liquid level controls which discharge into a weathering tank. A back pressure valve maintains a vent tank pressure of 60 pounds, which serves to transfer the fat oil through the heat exchangers and the preheater into the still. Back pressure of 30 pounds is maintained in the distillation unit. Still pressure passes the denuded oil from the still through the gravity exchanger from which a low pressure pump takes suction and passes the oil through the pressure exchanger, and the oil cooler into a surge tank from which it is taken by the high pressure oil pump and delivered into the absorbers. Oil level in the still is maintained by a float control which governs the speed of the low pressure pump handling the lean oil. The 60-inch x 36-foot bubble type still is equipped with reboiler, and end point is controlled by a direct wash of raw gasoline, which is pumped from the receiving tank into the control section in the top of the still, under control of a Tycos automatic temperature controller. Live steam for agitation is introduced in the lower part of the still, and condensate is drawn off at two different points in the column into



Interior power plant. Note details of arrangement of boiler control equipment



Distillation, re-absorber, and high pressure stabilizing equipment in compact layout at United Carbon Company's Alto plant

separators, the water as well as all steam condensate on the plant being trapped into the hot well for boiler feed.

A Southwestern Type P 24-inch x 42-foot fractionating column with 24 plates is used to fractionate the raw gasoline to any grade required. Raw gasoline is pumped direct from accumulator to fractionating column under control of a liquid level control which actuates the pump throttle.

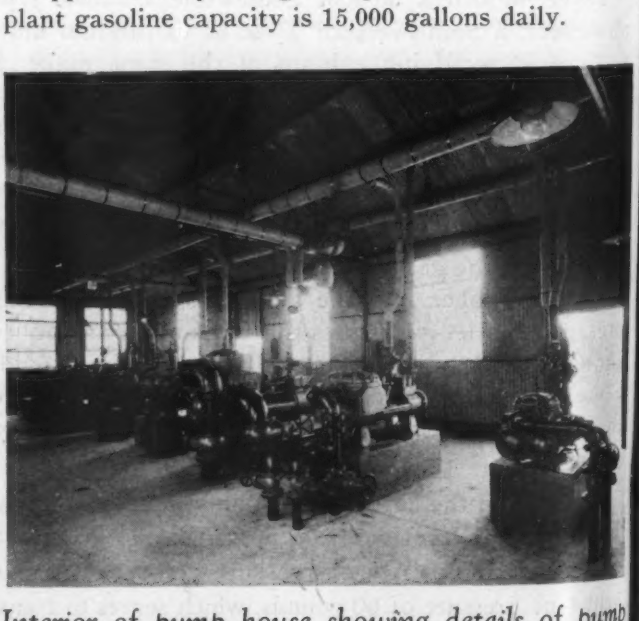
Uncondensed vapors from the distillation unit, as well as vent tank gasses, are treated in a 24-inch x 42-foot reabsorber, a considerable amount of stable gasoline being recovered in this manner, thus eliminating the use of a vapor recompressor. The residue gas from the reabsorber, as well as the light fractions eliminated from the raw gasoline in the rectifier are piped to the boiler fuel line, and furnish sufficient fuel for plant needs, an economical feature of plant operation. Oil for the reabsorber is taken from the main lean oil stream to the absorbers. Oil level in the reabsorber is maintained by a Chaplin Fulton liquid level control which actuates the throttle of a 6 x 4 x 6 duplex pump which takes suction from the bottom of the absorber, and discharges into the main fat oil stream before it reaches the exchangers.

All heat transfer equipment is of the multitubular closed type. All pumps are direct steam driven duplex piston pattern, each unit being provided with a standby. The cooled lean oil is handled against absorber pressure by a Worthington 16 x 7 x 18 block valve pump using metal snag rings for oil and piston packing. Cooling water is circulated by a Worthington 14 x 14 x 12 duplex piston pump with a capacity of 840 g.p.m.

Steam is generated by two 100 h.p. Casey Hedges R. T. and one 150 h.p. Scotch Marine boilers, one serving as a standby unit. These boilers are fed by a Worthington 12 x 4 x 10 ram pattern pot valve type pump, with standby. Water level in the boilers is maintained by automatic control apparatus assembled on the job, and consists of a steam trap connected to the water column of each boiler, which operates a common gas regulator installed in the feed line. A similar regulator on the feed pump steam line serves as a pump governor. This control is composed of standard equipment familiar to the average operator and is exceedingly simple in its arrangement, an important feature in the matter of maintenance and repair. It is thoroughly efficient in its operation, feed water level in the boilers being kept within a range of three-eighths inch. Gas feed to the boilers is controlled by a Chaplin Fulton automatic boiler gas governor which operates under steam pressure. Boiler room operation is thoroughly automatic, requiring a minimum amount of attention from the operator.

Finished product is pumped through a 2-inch all welded line 4.7 miles to the loading rack. Cooling water is supplied by a 5 h.p. two stage motor driven centrifugal pump operating at Boeuff River 1.2 miles from the plant.

The gas treated at this plant has a gasoline content of approximately 0.30 gallon per 1000 cubic feet, and plant gasoline capacity is 15,000 gallons daily.



Interior of pump house showing details of pump settings and arrangement of lines for steam, oil and water

Practical Results With the Edeleanu Process

By DR. J. ROSENBERG, Berlin, Germany

Translated from Petroleum Zeitschrift, 1930, pages 138-141

THE Edeleanu process of treating petroleum distillates with sulphur dioxides as a selective solvent has been applied in this country for several years in the refining of kerosene. Recently there has been some interesting work done in this country using this process in the refining of lubricating oils and reports of this work have aroused interest in the process and its application to such problems. The accompanying translation throws some light upon the employment of Edeleanu's process for treatment of lubricant stocks and gives many details of design and arrangement of equipment not heretofore covered so thoroughly.

ALL fractions of petroleum, gasoline, light oil, lubricating oils, etc., contain by-products in varying amounts, which must be removed by a suitable refining or purification process, in addition to the valuable ingredients which control the uses to which these fractions are put. The purification process, which has been used, up to the present time, has consisted of treatment with sulphuric acid, in many cases with fuming sulphuric acid. This treatment results in the partial destruction of the ingredients that are to be removed and partly in their conversion into waste products which are very inconvenient to handle, troublesome and useless. The quantity of the products that have to be removed by purification causes so high a refining cost in certain petroleum distillates of known origin, that the use of the distillates becomes impossible. Such distillates, after they have been freed from their gasoline content, are mainly employed, as a whole, as fuel oil. The refining costs attain accordingly so high a point for the one reason that large quantities of the refining agent—sulphuric acid—are required, and for the second reason that an important proportion of the original petroleum oil is destroyed by the refining agent.

The process that was invented by Dr. Edeleanu and that is named after him, which has for its purpose the separation of valuable products from the individual fractions of the petroleum by means of a solvent, has caused a change in this situation. The requirements that the solvent, which is used for this purpose, must meet are as follows:

In the first place, the selectivity of the solvent towards the individual ingredients of the original material must be as high as possible; in the second place, it must be easily separable from the hydrocarbons that are treated with it, so that it can be completely recovered; in the third place, it must be cheap everywhere and must be obtainable everywhere in any desirable quantities.

Liquefied sulphurous acid fulfills these requirements in a manner and to a degree which are not equaled by any other solvent. It dissolves aromatic, unsaturated and cyclic hydrocarbons with great ease, while the saturated, aliphatic hydrocarbons remain undissolved. The selective solvent powers of sulphur dioxide meet the very stringent requirements which exist at low temperatures particularly. The saturated, aliphatic hydrocarbons remain almost entirely undissolved at a temperature of —10°C. in sulphur dioxide, while the aromatic and unsaturated hydrocarbons are quite completely dissolved at this temperature. Sulphur dioxide has an extraordinarily low boiling point. It is known to be a gas at ordinary atmospheric pressure, boiling at—9°C., and hence it can be very easily removed from the individual portions of the treated petroleum fractions. The author, furthermore, has no knowledge of any solvent, which can be obtained cheaper and more easily than liquefied sulphur dioxide.

The basis of the Edeleanu process was obtained by the establishment of the properties and usefulness of liquefied sulphur dioxide for this purpose. While the laboratory testing of the process proved successful right at the start, and while it appeared that the process could be readily made commercial, nevertheless it was found that this was not nearly so easy as it appeared. The character of the solvent used—which is a gas at ordinary temperatures—made it necessary to work under pressure in a closed apparatus and at as low as possible a temperature. The latter condition is also required for the reason that the selective solvent properties of sulphur dioxide in the liquefied state are more favorably manifested at low temperatures.

PROCESS REQUIRES LOW TEMPERATURES

The cold that is required for carrying out this process is obtained by releasing the pressure in the liquefied sulphur dioxide in a certain point in the apparatus and

absorbing the vapors of sulphur dioxide which are formed on release of the pressure. The cold contained in the sulphur dioxide vapors that are removed is not lost; it is used to good purpose in a more suitable part of the installation. An additional difficulty encountered in carrying out the process was the fact that sulphur dioxide is known to attack with ease all metals in the presence of water, that is all metals that could be considered as structural material for building the apparatus. This difficulty became apparent, when we collected the moisture, which unavoidably reached the apparatus along with the oil in the stage, in which it vaporizes with the sulphur dioxide after the major part of the latter has been driven off. It is accordingly found advisable to locate drying towers at various points in the installation. The purpose of these towers is to dry the sulphur dioxide vapors, which are vaporized from the evaporators. This makes it possible to avoid the danger of corrosion in so thorough a manner that an installation, which has now been operating for 15 years, is still intact and is being continued in operation without change. Other means have also been available for overcoming the danger of corrosion, and these have been found highly useful. Such a means is for example the redistillation of a part of the liquefied sulphur dioxide, which is circulating through the apparatus.

The following is a brief account of the manner in which a modern installation working on the Edeleanu process is operated. After the oil, which has to be processed, is passed through dry filters for the purpose of removing the adhering and mechanically suspended moisture as thoroughly as possible and after it has been freed from inert gases that it may contain in a vacuum apparatus, it is passed through a preliminary cooler in which the oil comes in heat exchange contact with the cold refined product which runs out of the mixer. The oil then enters a second cooler at a temperature of approximately zero to 5°C. It is cooled in this cooler down to a temperature of approximately —10°C. by means of vaporizing sulphur dioxide, and it is then pumped into the mixer by means of a suitable pump.

REDUCE TEMPERATURE

The liquid sulphur dioxide, which is required for treating the oil, is taken from the sulphur dioxide collecting tank, in which the liquefied gas is contained under a pressure of three to four atmospheres. The liquid sulphur dioxide flows under this pressure into a preliminary cooler, wherein it is cooled down further by the extract mixture taken from the lower part of the mixer. The temperature of the sulphur dioxide is thus reduced to approximately zero to 2°C. and it then enters the sulphur dioxide cooler, where the pressure is released and the gas is permitted to expand and in which a vacuum is constantly maintained by removing a portion of the sulphur dioxide vapors in a continuous operation. This results in the attainment of the desired temperature of —10°C to —12°C.

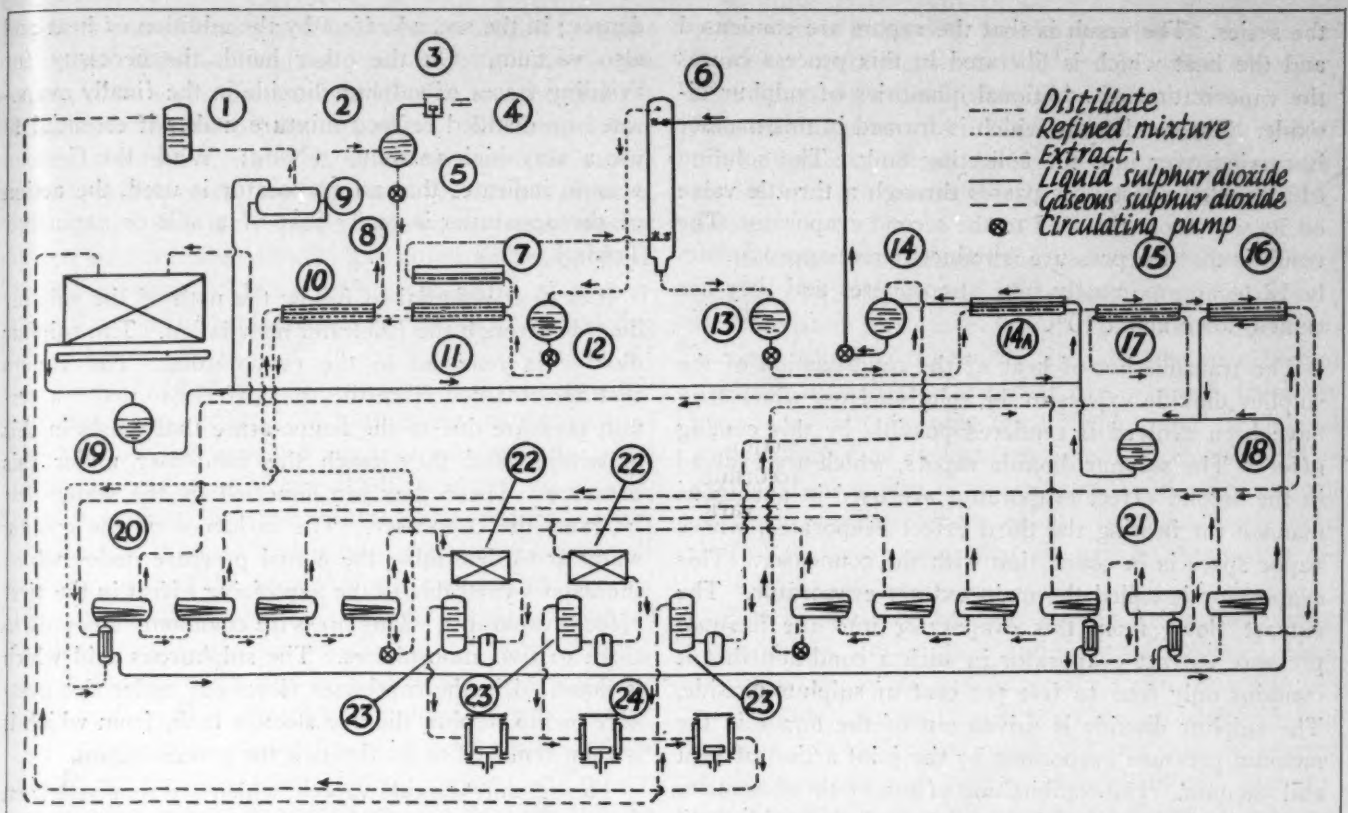
The resulting sulphur dioxide vapors then pass through a pipe connection, the special role of which the author intends to explain later in this discussion. The cold sulphur dioxide is transported by means of a pump to the mixer. The oil, which is also fed to the mixer, enters at the bottom and flows upwards, while the sulphur dioxide enters at the top and flows downwards in countercurrent flow. The two fluids therefore pass through one another and intermingle. The upflowing first becomes saturated with sulphur dioxide. As it passes upwards in the apparatus, the aliphatic hydrocarbons separate from the unsaturated hydrocarbons, which dissolve in the sulphur dioxide, while the aliphatic hydrocarbons, which remain in undissolved condition, flow upward.

Due to the fact that the oil flows up the mixer, the aliphatic hydrocarbons come into contact with pure sulphur dioxide in the upper part of the apparatus, and this sulphur dioxide washes out the last traces of heavy constituents from the oil. The washing process is therefore one which takes place progressively from the bottom to the top of the apparatus, and furthermore it is continuous. The intermingling and penetration of one medium into the other as well as the separation of the two are furthered by the difference in specific gravity between the oil and the sulphur dioxide gas.

DESIGN AND CONSTRUCTION VARY

The design and construction of the mixer vary according to the nature of the oil that is treated in it. The reciprocal intermingling and permeation of the oil and the sulphur dioxide suffices in the case of light hydrocarbons to effect separation of the various ingredients of the oil without the need of using any mechanical assistance. However, when heavy oils are being treated, then it is recommended that the proper type of mechanical stirring equipment should be used in order to secure an intensive admixture of the oil with the sulphur dioxide. For example, this may be accomplished by using a well-designed agitator in the mixer, or then again in another way by arranging within it suitable packing or filling to increase the time and surface of contact between the oil and the gas.

When a very heavy oil is being treated by this process, then the so-called countercurrent flow process is found to be worthy of use. In this process the oil that has to be treated is first subjected to the action of an extracting solution which consists of a solution of aromatic and unsaturated hydrocarbons in liquefied sulphurous acid. This solution is obtained from previous treatment of oil with sulphur dioxide. Such a solution should have first been used three times in succession before it can be applied to the treatment of the heavy



The illustration that accompanies this article shows in diagramatic form a modern installation working on the Edeleanu process. The direction of flow of the various liquid products through the plant are indicated by means of different forms of lines.

The various parts of the apparatus indicated are as follows:

(1) *Sulphur dioxide drying tower.* (2) *Distillate.* (3) *Vacuum pump.* (4) *Air.* (5) *Vacuum still.* (6) *Mixer.* (7) *Distillate cooler.* (8) *Finished refined mixture.* (9) *Sulphur dioxide still.* (10) *Preheater for refined mixture.* (11) *Preheater for distillate.* (12) *Storage tank for refined mixture.* (13) *Storage tank for extract.* (14) *Cooler.* (14a) *Sulphur dioxide precooler.* (15) *Extract preheater I.* (16) *Extract preheater II.* (17) *Finished extract.* (18) *Sulphur dioxide collecting tank.* (19) *Sulphur dioxide collecting tank.* (20) *Evaporators for treating refined mixture.* (21) *Evaporators for treating extract.* (22) *Gas coolers.* (23) *Drying towers.* (24) *Gas pumps.*

oil. The first treatment with the extracting medium or solution is followed by a second and a third treatment. This time the solution that is used should have been employed for the treatment of oil twice in the first case, that is the second treatment, and once in the final treatment. The final treatment of the heavy oil is then accomplished by means of pure liquefied sulphur dioxide. This oil can be advantageously treated in a mixer which is provided with Raschig rings.

The aforementioned aliphatic hydrocarbons, which flow out of the mixture and which contain approximately 12 to 15 per cent of sulphur dioxide, are designated as the refined solution. On the other hand, the mixture of aromatic and unsaturated hydrocarbons, which is dissolved in the sulphur dioxide, and of the other impurities in the distillate is designated as the solution of extracted materials or simply as the extract. Both the refined substance and the extract run out of the mixer into a container, which is designated as the extract and refined material feed tank. The cold solution of extracted materials flows continuously to a pump, which pumps it through a pipe to the aforementioned cooler or pre-cooler. In this apparatus the cold solution of extracted materials comes into contact with the sulphurous acid which runs out under pressure from the supply tank and thus there is interchange of heat between them, or rather cold, in this case.

ENTERS SECOND HEAT EXCHANGER

The solution of extracted substances, which now has a temperature of approximately 12 to 15°C., enters a second heat exchanger, which is designated as the preheater, and in which heat, which is contained in the finished extract, is recovered. Then the solution of extracted substances enters the evaporator installation, which consists of a series of evaporators. Complete separation of the sulphur dioxide from the hydrocarbons, which are dissolved in it, takes place in this apparatus.

The evaporation of the sulphur dioxide takes place in a number of stages. The mixture of extracts is heated in the first evaporator up to a temperature of approximately 60°C. by means of the waste steam from the steam engines. The sulphur dioxide vapors, which are thus obtained and removed from the apparatus, and which exist under a pressure of approximately 12 atmospheres, are used for heating the next evaporator in

the series. The result is that the vapors are condensed and the heat which is liberated in this process causes the vaporization of additional quantities of sulphur dioxide. The condensate which is formed in this manner is carried over into the collecting tank. The solution of extracted substances passes through a throttle valve on its way from the first to the second evaporator. The result is that the pressure is reduced from approximately 12 to approximately nine atmospheres and they are cooled down about 10°C.

The transmission of heat of the condensation of the sulphur dioxide vapors to the solution from which they have been evolved is rendered possible by this cooling effect. The sulphur dioxide vapors, which are evolved in the second effect evaporator, are used in analagous manner for heating the third effect evaporator, whose vapor space is in connection with the condenser. This evaporator is called the main extract evaporator. The extract flows from this evaporator into the medium pressure extract evaporator in such a condition that it contains only four to five per cent of sulphur dioxide. The sulphur dioxide is driven out of the liquor in the medium pressure evaporator by the joint action of heat and vacuum. The combination effect of these agencies causes further vaporization of the sulphur dioxide until the amount remaining is only approximately 0.6 per cent. The extract flows out of the medium pressure evaporator into a third, and in certain instances, a fourth evaporator, in which a high vacuum is maintained. The last traces of sulphur dioxide are removed in these evaporators and under certain requirements the content of sulphur dioxide in the extract can be reduced to as low as approximately 0.02 to 0.04 per cent.

The path which the refined materials travel in opposite direction to the flow of the solution of extracted substances is quite similar. The refined materials flow out of the upper portion of the mixer through the pre-cooler, which was mentioned above, into the pre-heater. The cold mixture of refined materials in the pre-cooler enters into heat exchange with the oil that is to be treated with the sulphur dioxide with the result that the temperature of the refined substances is raised to approximately 10 to 15°C. The refined materials then enter the pre-heater, where they are again in heat exchange with the refined substances, that have been removed from the last evaporator in which they have been treated and that have hence been freed of their sulphur dioxide content.

EVAPORATION IN THREE STAGES

Then evaporation follows in three stages: in the first effect or principle evaporator set aside for treating the refined substances; the middle effect or medium pressure evaporator, and finally the vacuum evaporator, or last effect. Evaporation takes place in the first effect only by heat added under the pressure of the condenser; in the second effect by the addition of heat and also vacuum. On the other hand, the necessity for avoiding traces of sulphur dioxide in the finally evaporated or distilled refined mixture makes it essential to use a very high vacuum. (Note: While the German version indicates that an evaporator is used, the action of the apparatus is really that of a still or vaporizer. Trans.)

It is next essential to follow the path of the sulphur dioxide through the Edeleanu installation. The sulphur dioxide is removed in the evaporators. The vapors that are obtained from the first effect are under a certain pressure due to the temperature that exists in this apparatus, and they reach the condenser under this pressure. There they are liquefied by the water that irrigates the condenser. The influence of the cooling water is to determine the actual pressure under which the vapors exist due to the vaporizing effect in the first effect evaporator. This pressure commonly amounts to three to five atmospheres. The sulphurous acid which is liquefied in the condenser flows out under this pressure to the sulphur dioxide storage tank, from which it is then removed to go through the process again.

The sulphur dioxide vapors, which are removed from the second effect evaporator for the extracted solution and the second effect evaporator for the refined mixture, which vapors have an approximate temperature of 60°C., are united in a common pipe and enter the mixing apparatus, in which they are united with the sulphur dioxide vapors which are sucked out of the sulphur dioxide cooler. The sulphur dioxide vapors, which are removed from the evaporators, cool down considerably in this mixing apparatus, and as a result of this cooling the oil vapors, which are carried along, are separated. These oil vapors are mechanically held by the sulphur dioxide vapors as they leave the evaporators. The sulphur dioxide vapors, after the light hydrocarbons have been precipitated, leave the mixing pipe together with the latter and enter a separator, from which the condensed light oils are removed from time to time.

VAPORS FREED FROM MOISTURE

The sulphur dioxide vapors, which are freed from the light oil, flow through a drying tower and are there freed from traces of moisture contained in them. The sulphur dioxide vapors, which are removed from the vacuum or third effect evaporator, treating the extract, and also from the third effect evaporator, treating the refined mixture, are united in a sulphur dioxide gas cooler, which is cooled by means of sulphur dioxide vaporizing at the low temperatures of —10° to —12°C. The result is that light hydrocarbons with low boiling points, which have been distilled over in the vaporization of the sulphur dioxide are condensed.

The condensed light oil constituents pass over with the sulphur dioxide gas flow into a separator, where they are separated from the sulphur dioxide, while the

latter is passed into a drying tower in order to remove traces of moisture contained in the gas. A vacuum pump then sucks the sulphur dioxide vapors under a high vacuum out of the apparatus and brings them under a pressure, which those sulphur dioxide vapors possess which come from the second effect evaporators. The united sulphur dioxide vapors are sucked out by means of a sulphur dioxide gas pump and compressed to the pressure of the condenser in order to be condensed again in the condenser by means of the cooling water.

From what has been said before, it is seen that the purified hydrocarbons which flow out of the cycle of the process are removed at approximately the same temperature as that of the oil which enters the cycle. It is also evident that the cold that is produced in the process and the heat that is used therein are completely utilized through the agency of the counterflow apparatus. Inasmuch as a loss of material cannot be incurred in this process—the oil which must be worked up is divided without loss into two portions only—while the sulphur dioxide is completely recovered, so that only very inappreciable quantities of the substance goes to waste, namely that which remains behind and is not practical to remove from the refined mixture and the solution of extracted substances, it is therefore easy to see that the consumption of sulphur dioxide in this installation is limited only by the quantity of steam which is required for vaporizing the sulphur dioxide and also by the energy which is required for the compression of sulphur dioxide vapors and for moving the product around the works.

This quantity of steam and energy per ton of distillate produced is extraordinarily small in large installations. When the compressors are driven by steam engines and the exhaust steam is used for heating the evaporators, then the consumption of steam amounts to approximately 200 kilograms (440 pounds) per metric ton (204 pounds) in a plant which processes a daily throughput of 500 tons of kerosene distillate (550 tons English system). There are also required three kilowatt hours of electricity for operating the motors which drive the circulation pumps. These figures have been more than substantiated in practice, for it has been found that they were bettered under favorable operating conditions.

LABOR COST SMALL

The labor involved in taking care of the installation is small. The entire process is continuous and manual labor is required only in very small amount. The life of the apparatus comprising the installation may be said to be almost unlimited, for the installation in question has been operating since 1913 and is still being operated in uninterrupted continuity without there having been any necessity for replacing any important part of the equipment. These results were obtained by maintaining a strict connection between science and technology.

Edeleanu installations have been built for refining gasoline, lighting oil and lubricating oil. This process is designated as a true refining process in the most accurate sense of the word. It should be remembered that the refined products that are obtained from the process are not the only results which may be claimed to be obtained as of a strictly improved character. The extracted substances or the extracts, as they are termed, are also products whose quality is much better than that of the by-products that are usually obtained in the refining of oil.

Thus it must be brought to mind that the extract contains the unsaturated and aromatic hydrocarbons. We may take as the raw material a Californian lighting oil distillate. In the treatment of this oil with liquefied sulphur dioxide approximately 22 per cent of extract is obtained. This extract is then redistilled. The portion that passes over above a temperature of approximately 225°C. may be utilized as an addition to a motor fuel to make it anti-knock and to obtain higher compression in the internal combustion engine. In Germany a mixture of benzol and toluol is used to produce an anti-knock fuel. This mixture is here replaced by the addition to the motor fuel of certain constituents in the crude oil, which have heretofore been thrown away in the by-products.

The extract that is obtained from the treatment of lubricating oil by this process, also finds valuable use as a lubricant possessing a very low cold test. The Edeleanu process can also be used in the production of a very high quality gasoline with anti-knock properties and high compression qualities.

Such a gasoline may be produced in the following manner. The saturated aliphatic hydrocarbons are removed from a higher fraction of gasoline, that is one that passes over between the temperatures of 170 to 225°C., by means of the sulphur dioxide refining process. The unsaturated hydrocarbons, which are dissolved in the sulphur dioxide, are added to the lower fraction of the gasoline. It was thus proven that the knocking of gasoline is due to the saturated aliphatic hydrocarbons which are present in the higher boiling fractions of gasoline. These hydrocarbons are very well suited for use as illuminants.

Arkansas Natural Gas' Cartersville Plant

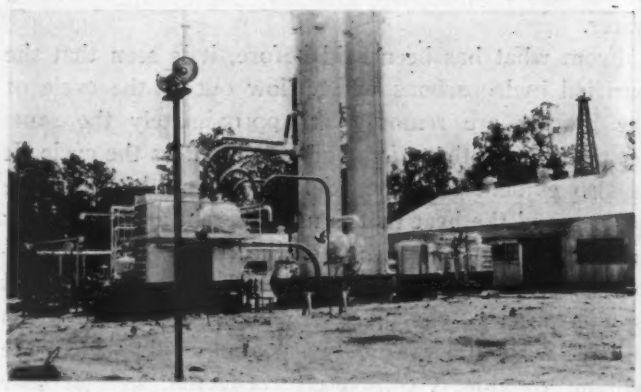
ARKANSAS NATURAL GAS CORPORATION has erected a 10,000 gallon gasoline extraction plant in the Cartersville area of Bossier Parish, Louisiana, about 45 miles northeast of Shreveport. The plant is operating on gas from the local field securing a recovery of about 2.25 gallons per 1000 cubic feet as against a test recovery of two gallons.

Construction of the installation was completed in about three months time and this despite the fact that all equipment necessary for complete plant operation had to be hauled into this low-lands field over single track roads of the corduroy type, which for the most part constitute the roadways leading into all parts of the field. The plant is of the latest design of Southwestern type 220 incorporating a degasifyer between exchangers and preheater, and reboiler near the bast of the distilling column. All of the gathering lines transporting gas to the plant are of welded construction. The unit was erected by E. P. Farmer, formerly in charge of the Monroe, Louisiana, plant for the same company, and under the supervision of K. E. Jones, head of the natural gasoline department.

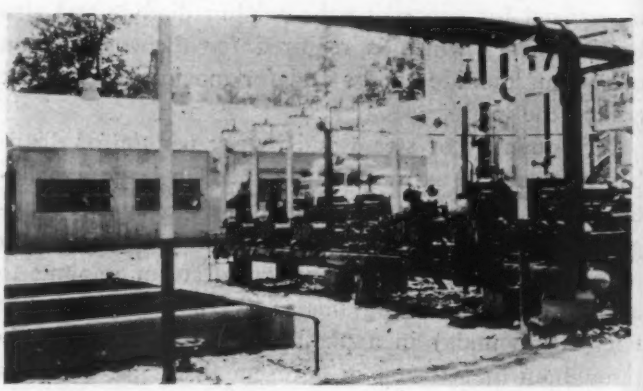
A location of slightly higher elevation than surrounding territory was selected and the plant layout is that of the customary rectangular type, with office, auxiliary building, cooling tower, power plant and tank storage occupying the corner positions, leaving the absorption plant proper centrally located. A corduroy roadway leads into the plant site through the lower land surrounding it.

Gas is handled in the usual manner through four Cooper-Bessemer compressors, discharged through Southwestern coolers and scrubbed into the absorption column from which it passes into residue lines. Absorption oil and water is circulated through the system by Worthington pumps, there being standby units in each case. Water is used for condensing purposes. Gasoline is used as the cooling medium in the reflux condenser system.

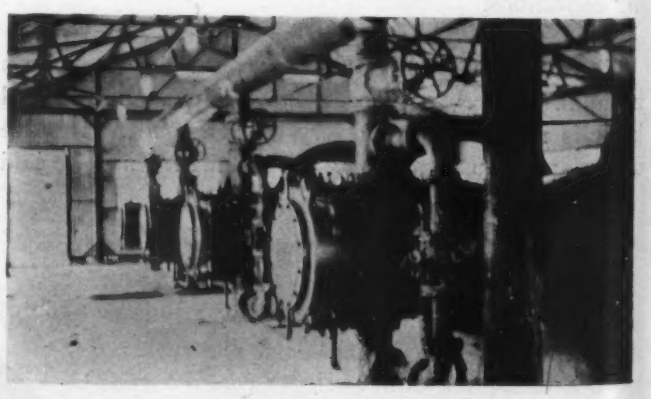
Enriched absorption oil from the absorbers passes into the exchanger equipment and then through a degasifier before it enters the preheater and into the still. Vapors evolved through the preliminary heating in the exchanger system is thus liberated through a vapor line leading to a point near the bottom of the still. This is an improvement in design, eliminating the necessity of venting each section of such



Exchanger, preheaters, absorption and distillation systems, Arkansas Natural Gas Corporation, Cartersville, Louisiana



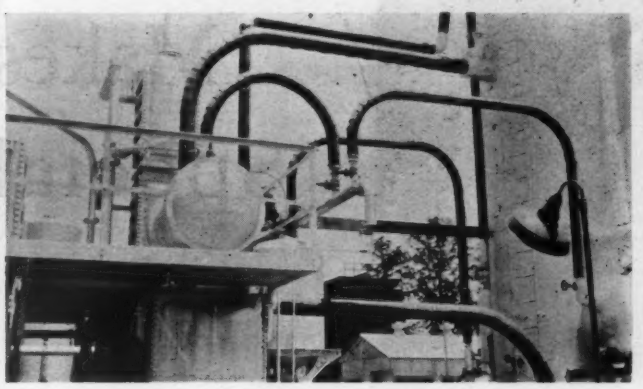
Rich and lean absorption oil and reflux pumping equipment



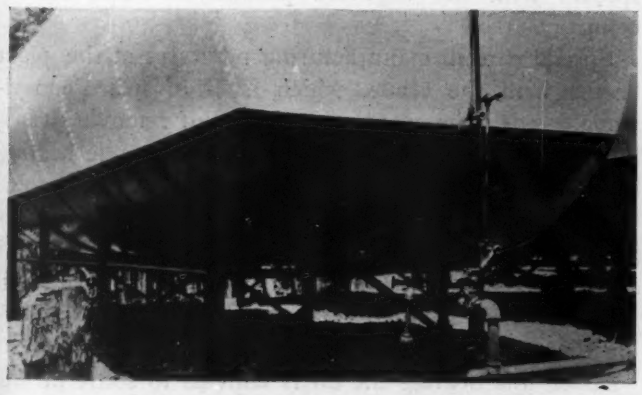
Interior gas compression house

equipment or vapor accumulation troubles in the upper sections of the preheaters. The vapors enter the still and rise upward through the trays and are subject to such rectification as is required along with the main stream of vapors liberated in the still.

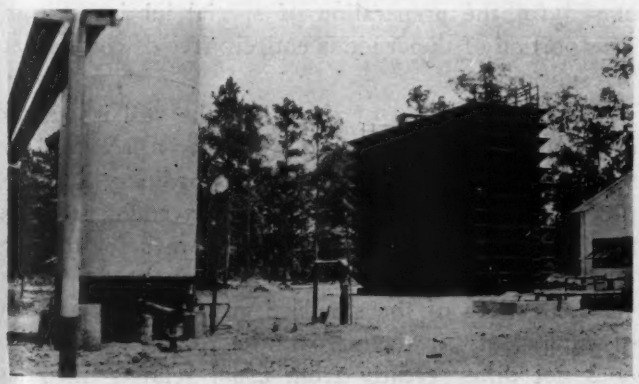
The still in this design is also equipped with a reboiler section placed near the bottom and at one side of the column where live steam is employed to maintain the temperature desired on the absorption oil. Two dehydrators are provided which bleed water off two of the bubble trays. The system is operated at 35 pounds working pressure, and to produce grade AA gasoline.



Degasifier placed between exchanger and preheater equipment



Gasoline storage tanks supported by welded structural work made of junk pipe



Water well-head in foreground, cooling tower and water storage tank

AUXILIARY FACILITIES

In the auxiliary house a 45 horsepower Cooper-Bessemer gas engine is employed to belt drive a main shaft from which auxiliary equipment is also belt driven. This equipment consists of a belt-driven generator for the provision of lights about the plant yard, a Gardner-Denver air compressor which supplies air for flowing the water well and either of two centrifugal pumps employed to circulate the hot water over the cooling tower.

Water for plant operation and cooling is secured from a well located near the center of the plant yard 123 feet deep. It is jetted with air at 35 pounds pressure and the fresh water accumulates in a large vertical tank located adjacent to the well head. After use and when warm the water is circulated over the Fluor cooling tower where the temperature is lowered from about 96° to 78° F.

This well water is also used in the boilers and is passed through a Southwestern condenser section in proper proportions to effect the condensation of exhaust steam which is also conducted to the condenser. From this point the condensed water and the warmed fresh water flow into the boiler water make-up tank and feed into the four horizontal return tubular boilers.

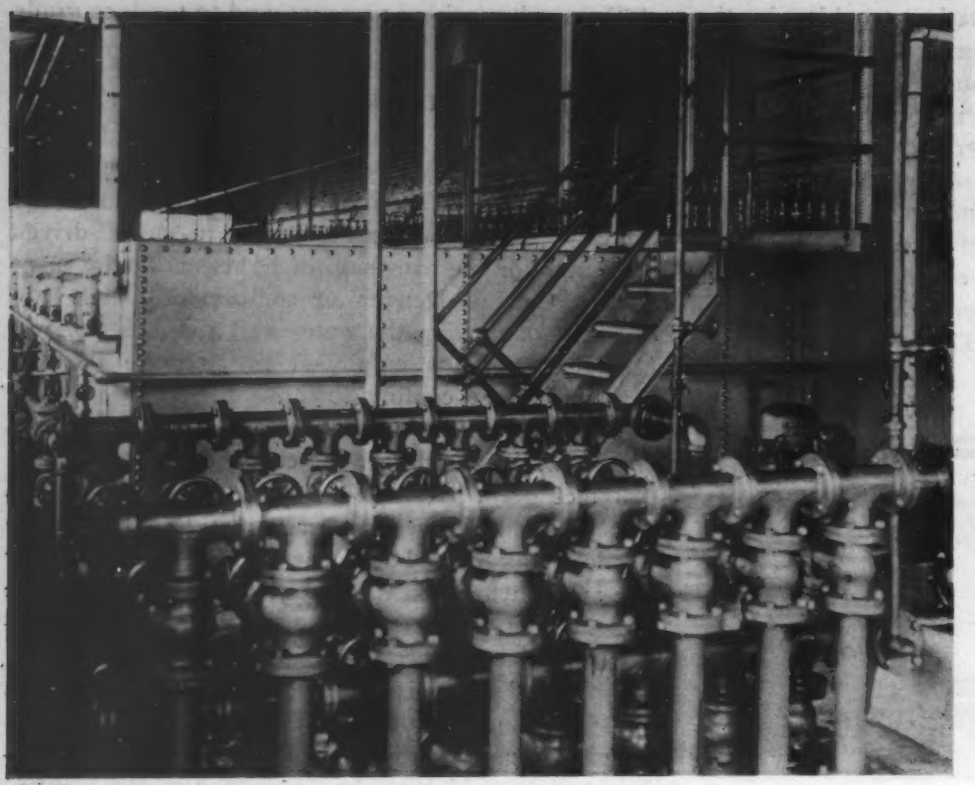
In the operation of these boilers there is interesting departure from usual practice in that a pit the size of the fire box in horizontal dimensions has been dug to a depth of four feet. This pit has a concrete base and the walls are of fire brick and refractory cement. In this manner the boilers are underfired through the enlarged combustion area. It is said that this type of firing secures a lower fuel consumption and protects the boilers from damage by flames thus increasing the length of service.

WELDED TANK SUPPORTS

The four gasoline storage tanks provided at this plant are supported on a home-made framework of used pipe. The tanks are 10 by 30 feet in size. A fifth and smaller tank is used for absorption oil storage.

The tanks are cradled or saddled in bands of iron cut from an old tank, there being four cradles under each tank. This cradling is supported by the structural work made from old junk pipe and fabricated by the welder on the plant yard. The four cradles and supports are imbedded in small concrete bases or pairs. In this type of support the structural fabrication is salvageable and can be readily moved, with the exception of the concrete bases.

Vapors derived from the stock tanks and the the accumulator tanks are recycled through the system and it is said that this practice has a tendency to stabilize the final product somewhat.



United Company Makes Special

Filtrate receiving house showing details of manifolding inlet and outgoing lines

UNITED Refining Company, at its Warren, Pennsylvania, plant does not accept the usual yields of customary products from its Pennsylvania crude oil, nor remain content in the production of standards of the trade. The organization may well be classified as specialists in the production of specialties, for in addition to the preparation of a large number of special naphthas the company produces a wide variety of special lubricants, with all products commanding premium prices. Products in fact, at this plant are continually being prepared on specifications of individual customers to meet requirements peculiar to the customers industrial enterprises.

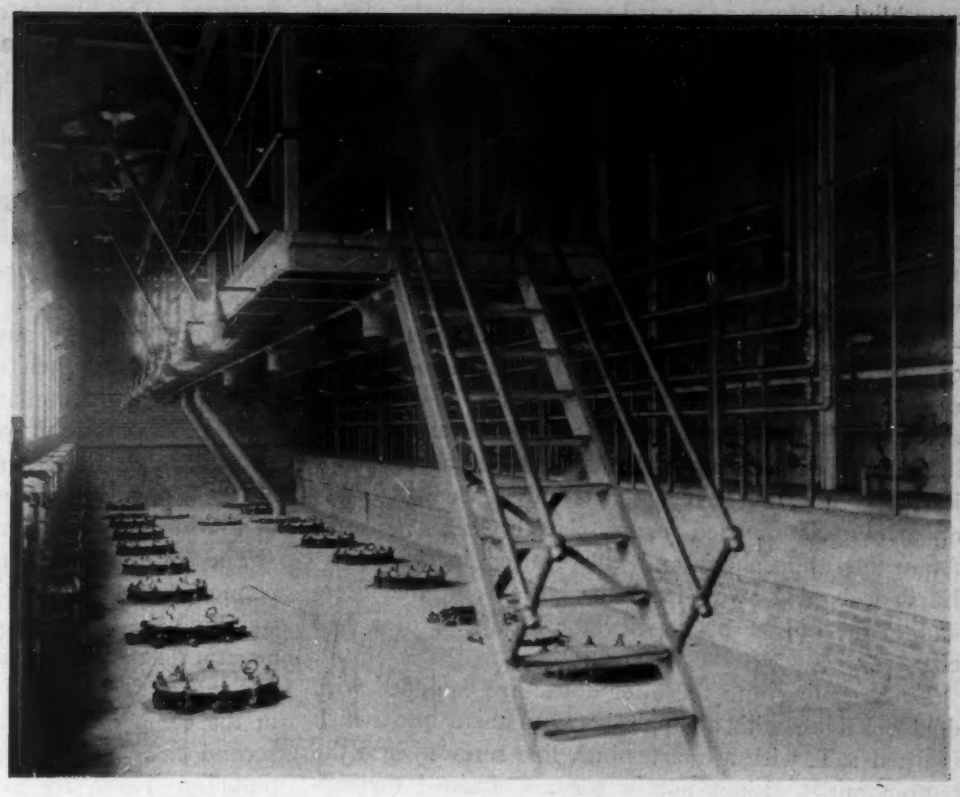
Such a business as this is built up only through accurate knowledge of the raw materials, scientific control of each processing step; and requires the application of technical manufacturing skill and salesmanship. As in every other industry, products which are of special quality produced to fulfill requirements that are individual and perhaps limited in their utilization, command a higher price than ordinary standard products. More equipment is required, more processing steps are necessary for the perfection of individual products, additional storage and working capacity is needed, and scientific, accurate, and continuous control from the research and testing laboratory is essential. All these requirements are met by this organization, and several years of experience in the preparation of such specialties has resulted in the establishment of a valuable reputation among consumers whose requirements are special, with the expected profitable results to the company.

Special care in manufacturing processes at this plant begins with the crude, which is Bradford, Pennsylvania, grade. The customary method of removing gasoline, kerosene, gas oil and wax distillate in one heating is not practiced, but the crude from which a large number of special premium products are to be made is given the treatment warranted by a valuable scource of such materials. It is first handled through a steam still where open and closed steam is employed for removing the gasoline fraction.

After this heating the oil is allowed to settle in this still for six hours before it is transferred by pump to a second still. In this transfer the outlet line from the still is considerably above the bottom of the still, so that only the top layer of settled oil is removed and employed for the preparation of special lubricating oils. This portion of the crude is entirely free of contaminating substances.

The lower portion of the oil in the still is pumped to another part of the plant where it is processed for the preparation of conventional or ordinary standard products. The gasoline fraction removed by steaming may be fractionated in a number of ways for the production of special naphthas, or it may be finished to various grades of the standard gasolines. The system of equipment for the preparation of special products does not differ greatly from usual refining facilities, the chief difference in the preparation of specialties being in more available equipment, the utmost care in

Refining Plant Many Products



Reburned earth is conveyed from steel cars pushed on to the suspended track platform to any of the 16 filters through spouts as shown in the background

handling and precision methods in processing under constant control.

TEMPERATURE CONTROL

Precision methods of operation at this plant have been carried into such departments of the plant as automatic control of temperature of oil going to the wax presses, and automatic control of temperatures in the wax sweating plant. In the first instance, as in the second, it is thought that United Refining Company has pioneered in the development of application of control devices to the regulation of such temperatures, in which work they employed Tycos instruments. In the control of volume of brine at controlled temperature as it passes through the chillers the temperature of oil passing through the chillers is regulated, with the result that cold tests are uniform to a marked degree. This control of temperature gives the cold test desired on the finished product, it is said, and the chief advantage is uniformity.

In the control of temperature of wax sweating processes the chief advantage is again uniformity of finished wax, and the elimination of much of the human element in the sweating procedure. The control instrument in this case regulates the amount of warm water going to the coils in the sweating pans. Control is not strictly automatic since the instrument must be reset to secure various temperatures. However, the operator in charge of the sweating plant has orders from the superintendent to raise the temperature of the wax being sweated at such and such intervals to such and such degrees Fahrenheit; and all that is necessary is a quick resetting of the control instrument and the proper temperature is quickly secured and held at this point until orders call for additional heat. The intervals and the temperatures employed are based on experience with the type of product being sweated and the type of finished wax desired. Experimental work at this plant has indicated that this type of control results in assured uniformity of the finished wax and permits a definite working schedule to be prepared for the wax sweating department.

FILTER AND COMPOUNDING PLANTS

Additions to this plant during the past year or so consist in a new filtering and earth-burning plant, and a new compounding and shipping plant. The filter plant houses the Herreshoff clay roasting furnace, filters, and part of the laboratory. It is built of brick and concrete with wire-glass windows set in steel sashes. The building houses 18 seven by 15-foot percolating filters each having a capacity of 10 tons of fuller's earth. On the top floor of the building are two upper man-heads of the filters and the oil charging tanks, as this is the charging department. The oil manifolds are placed on one side of the house, and the manifolds for naphtha, steam, and air, for washing and cleaning the filters are installed on the other side.

In lighting the filters during clean-out periods and to minimize the danger from explosion from electric sparks, all of the filters are provided with a small

searchlight known as a yard engine searchlight placed directly above them. These lamps throw a wide light into the filter so that the bottoms and sides are well lighted without lowering a lamp on a cord into the vessel. All electric switches are placed outside of the building.

An elevated and suspended platform extends down the center of the room which is fitted with tracks for the steel cars in which the earth is handled. Hatchways are provided in the floor at points opposite the manheads on the filters and spouts are at hand from conveying the earth into the filters. Steel hand-pushed cars of earth are hauled on tracks from the furnace and raised to the charging platform on an elevator. It is said that revived clay is handled in cars as described in preference to conveyors, for the reason that less opportunity is afforded for the clay to absorb moisture from the atmosphere and thus lower its efficiency. Earth is hauled away from the bottoms of the filters and to the burner bucket-elevator by means of a belt conveyor.

Lines leading into the filter house are equipped with double valves, with a nipple between them into which is fitted a T, with a quarter-inch line screwed into the bottom outlet. Lines not in use are drained through this arrangement through a quarter-inch valve on the drain line.

The filtrates flow from the filters into a separate portion of the building on the ground floor, with each filter discharging into a separate tank which is of sufficient capacity to bring the oil to color specifications. The filtrate manifolds are located near the walls and above the tanks and conveniently reached from a safety walkway provided along the tops of the tanks.

The compounding plant is in effect a three-story building, with tankage place around the walls of the second floor, loading space and the like on the shipping floor, and a semi-basement. The plant is of brick, concrete and steel construction with heavy steel beam supports used throughout and to such extent that much additional tonnage such as more oil storage tanks, may be added when needed. The basement is employed for painting and repairing steel drums and for the cooperage department where wooden barrels may be made or repaired. A large proportion of the oil is shipped export in wooden barrels, and consists of a wide variety of industrial lubricants.

The lower floor is used for barreling the oil, compounding and mixing in two tanks for this purpose, weighing the packages on either of two scales, and the general detail work relating to oil shipment.

Tank storage for various grades of lubricants handled in the compounding plant consists of 14 tanks on the second floor and along the sides of the rectangular building. There are five 30,000-gallon tanks, with the remaining tanks having a capacity of 9000 gallons each. Each of the tanks is provided with double bottoms, with the lower bottom flat, and housing steam coils. The inside tank bottom is sloping to expedite cleaning. Steam traps are provided on the outlet of each of the steam heating coils; and the condensed water is conducted to the sewer. These coils are for the purpose of maintaining the oil warm during the colder weather. All of the tanks are provided with direct reading permanently attached gauging devices. Each tank is piped with separate piping, and piping is so arranged that all tanks can be transferred from one tank to another in any manner desired without leaving the barrel house, or without mixing. All of the pumps are motor driven, with inside push-buttons controlling remote switches located outside of the house. The barreling - compounding plant was built with the view of safety of operation, elimination of contamination of various grades of oil, and speed and convenience in barreling and shipping.

Details of construction, design and layout of United Refining Company's barreling and compounding plant

Chemical Treatment of Petroleum Distillate

V. Alkali Washes and Doctor

By L. J. CATLIN
Chief Chemist, The Standard Oil Company of Kansas

CHEMICAL control of alkaline treatment is a much more exact science than acid treatment for several reasons. In the first place the impurities for which alkaline treatment is used are quite definitely known, and may be segregated and identified readily by the plant operator. In the second place, most of the reactions by which these impurities are removed are known and their formulas enable the laboratory to follow the course of the reaction both quantitatively and qualitatively, and thus determine whether full use is being made of treating solutions. Incidentally, there is no better place in this series for a little lesson in elementary chemistry, for those operators who care to know a little more about how the chemist uses a chemical formula.

A formula is a shorthand statement of a chemical reaction, using abbreviated symbols to represent chemical compounds; but a correct formula may be expanded to mean a great deal more than a mere sentence. It may reveal enough to fill a page, or a volume; or to put it another way, it may reveal enough to save hundreds or thousands of dollars worth of materials. We will illustrate by discussing two formulas connected with alkaline treatment, namely, that by which hydrogen sulphide is removed, and that by which mercaptans are converted to disulphides, which is the true sweetening reaction of doctor. The former is too old to know its origin, but the latter as it relates to sweetening of distillates was perhaps first made available to oil chemists in 1924 as a result of studies by Wendt and Diggs, and by Wood, Lowy and Faragher.

H_2S REMOVAL

Hydrogen sulphide may be removed by the use of caustic soda alone. The formula for the reaction is written thus:

$$H_2S + 2NaOH = Na_2S + 2H_2O,$$

reading, hydrogen sulphide plus sodium hydroxide results in sodium sulphide plus water. We will now enumerate a few of the things a chemist can see in addition to that just stated.

1. Hydrogen sulphide is of an acid nature and sodium hydroxide is alkaline, indicated by the H_2 and OH respectively, which result in water as a product of the reaction.

2. This suggests that any chemical having an alkaline nature expressed by OH in its formula may be used in the place of sodium hydroxide for removing hydrogen sulphide; such as hydrated lime $Ca(OH)_2$; caustic potash KOH; ammonium hydrate NH_4OH; etc.

3. H_2S is soluble in oil, while Na_2S is insoluble, hence the sulphur content of the oil is reduced by the reaction.

4. One molecule of H_2S requires two molecules of sodium hydroxide, hence for a given amount of H_2S there is required a certain definite amount of NaOH, and less than this amount will not completely remove the H_2S, while more than this amount will be wasteful of NaOH.

5. Any test which shows the presence or absence of H_2S in the oil may be used to determine the completeness of its removal, while a test which shows the absence of NaOH in the water solution may be used to determine the efficiency of the application and use of the caustic.

The above formula is here used for illustrative purposes, and may represent the final aim of control efforts, but as a matter of fact the possibilities of use of the caustic soda is only half exhausted at this point and may be continued till the reaction reads,

$$H_2S + NaOH = NaHS + H_2O$$

in which the same amount of hydrogen sulphide is removed by one-half as much caustic soda, as in the previous formula. The determining factor will probably be whether the reaction becomes too slow or incomplete to warrant continuing to this point. If sufficient stages of treatment, such as towers in a continuous system, are provided, the caustic may be used till the final reaction is completed, by using

fresher caustic following the more completely spent material. This is just another place where the principle of counterflow may be used to advantage, similar to that employed in acid treatment, or heat exchangers, multiple-pass tube stills, etc., where the most nearly exhausted material comes into play on the freshly treated material, while the least exhausted material puts the finish on the outgoing stream of treated product. We perhaps should state further, that the principles involved in the numbered conclusions given above, apply only to the removal of H_2S by chemical reaction, and not to the case of merely dissolving of the gas in a liquid such as water, where the quantitative relations are not quite so definite.

MERCAPTAN REACTION

The general formula for the reaction of mercaptans with doctor solution, as ordinarily encountered by the treating plant operator may be written in two stages, as follows:

$$2RSH + Na_2PbO_2 = Pb(RS)_2 + 2NaOH,$$

$$Pb(RS)_2 + S = R_2S_2 + PbS.$$

The first formula reads: mercaptan plus sodium plumbite equals lead mercaptide plus sodium hydroxide and the second: lead mercaptide plus sulphur equals alkyl disulphide plus lead sulphide. And the two formulas represent the two stages in the doctor reaction, which are familiar to all treators. In the first stage the oil becomes colored, anywhere from green to orange, if hydrogen sulphide has first been removed, and if given time enough a curdy precipitate of orange or brown color may settle out leaving the oil fairly clear, or it may remain suspended indefinitely. This is lead mercaptide.

In the second stage sulphur is added till the lead mercaptide color gives way to black, indicating the formation of lead sulphide, which settles rapidly or may be filtered out of the oil leaving it clear, while the disulphide goes back into solution in the oil. Recent investigations under Project 28 of the American Petroleum Institute Research, have shown that not all mercaptans react identically, but so far as the operator is concerned in this case, he has assurance that when the reactions here given are completed, the oil will pass the usual specifications, because the testing reagent is the same as the treating reagent.

As in the case of hydrogen sulphide formula, a number of helpful deductions may be made from the formulas here given:

1. The amount of lead precipitated from the doctor will be in proportion to the mercaptan in the distillate treated, and when the soluble lead is all removed from the doctor solution this reaction will cease.

2. If lead mercaptide could be successfully precipitated as such, it would result in actual removal of this sulphur component from the oil, whereas in the next stage it returns to an oil-soluble form, and the oil is sweetened without reduction of sulphur content.

3. When the lead is taken out of the doctor the caustic soda returns to its original formula and can be used for dissolving more lead.

4. In the second stage of the reaction the amount of sulphur required to complete the reaction is proportional to the lead taken from the doctor. The ratio is about one pound of sulphur to seven pounds of litharge. Thus in treating where sulphur is added in the form of flowers of sulphur, this may serve as a general guide to avoid excessive sulphur. Precipitation may be brought about with less than this amount of sulphur in some cases, but more than this ratio will be useless. Or reversing the case, if the amount of sulphur added to barely accomplish precipitation is known, we may predict how much litharge will have to be added to the doctor to restore it to its original condition.

5. If all the precipitate is collected the lead lost from the doctor is available for restoring or sale.

The above conclusions from consideration of the chemical formula serve as excellent guides in treating plant operation. They, of course, assume previous removal of hydrogen sulphide. Some deviations are naturally to be expected, and some have been accounted for. If a caustic wash is used ahead of the doctor, some of the lower boiling mercaptans will also be removed by this wash. Likewise sulphuric acid treatment effects partial removal. Many investigators as well as operators report beneficial effects from recirculating lead sulphide (blackstrap) and this is generally explained as a process of absorption of the mercaptan without other chemical action. In another case air is blown in with the recirculated sulphide and enters into the reaction in some unexplained manner.

PRECIPITATION

Lead mercaptide, as it forms is in a state of colloidal dispersion, which simply means that the particles are so small that they cannot overcome the frictional resistance of the oil in settling, and cannot be filtered out by ordinary means, as with filter paper. Such materials as filtercel may be used to produce a medium fine enough to remove it, and large enough to settle, but such operations are too expensive to be practical on a commercial scale. will to a certain extent coagulate it into particles Failure to precipitate lead mercaptide may lead to various complications. In a distillate which is very sour, a large amount of lead may be lost from the system by allowing it to carry over with the oil in the form of mercaptide. If the distillate is to be rerun, as with steam distillation the lead will be left in the still or carried away in the water drawoff. If it is not rerun the lead will remain suspended for a long time causing cloudiness or discoloration of the oil. In distillates which are only slightly sour the

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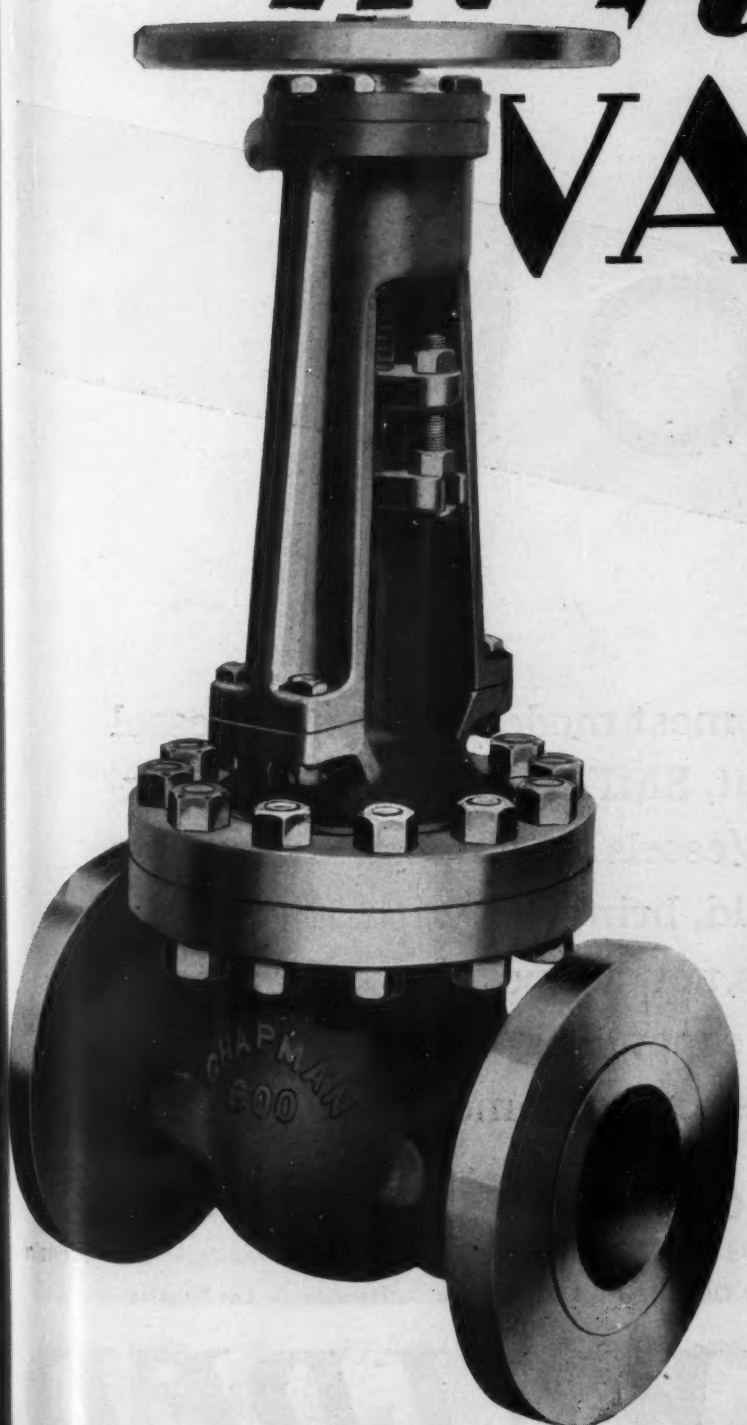

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lead mercaptide may escape in the oil without being noticed except as cloudiness in a color machine, or become an emulsifying agent for dispersing oil in the caustic solution of the doctor. In this case the oil passing out of the system is effectually cleared, but the doctor soon becomes emulsified to a thick curdy mass containing as much as 75 per cent oil, and requiring days or weeks to separate by merely settling. Such emulsions may however, be quickly broken by adding hydrogen sulphide, or sodium sulphide obtained by prewashing with caustic for hydrogen sulphide removal, thus converting the lead mercaptide to lead sulphide which does not cause such emulsions. Free sulphur should produce the same result, but is impractical because the mercaptide is in the oil phase of the emulsion and is effectually protected from access by free sulphur by the caustic solution surrounding it.

The most effective method of preventing the difficulties just enumerated is by continuous addition of sulphur in the amount required to change mercaptide to sulphide. For a continuous system this may be accomplished by dissolving the sulphur in oil and proportioning this to the doctoring stage as required. The next best procedure is perhaps addition at regular intervals at the doctor pump and carrying considerable lead sulphide in the doctor. Chemists for smelters buying lead sulphide from refineries have reported to the writer cases where they contained as much as 10 per cent free sulphur, which points to the ability of lead sulphide to assist in doctoring by distributing intermittent dumps of sulphur to the oil as needed in the doctor reaction.

ROUTINE TESTS

Based on the above considerations we may outline a testing routine for plant operators which will show them just where they are at any time with the sweetening reactions. If caustic is used for removal of H_2O a sample of the treated oil may be tested by agitating with a solution of lead acetate which is kept acid in reaction by adding an excess of acetic acid. A black precipitate of lead sulphide in this test indicates the presence of H_2S in the oil. A solution of cadmium chloride may also be used, in which a yellow precipitate indicates H_2S. If the caustic is used continuously till spent, the testing of its condition is better handled by the laboratory. However, if the efficiency of mixing of oil and caustic is assured, the operator may operate on the basis of the tests shown on the oil, and assume that the caustic is spent when it does not completely remove H_2S from the oil.

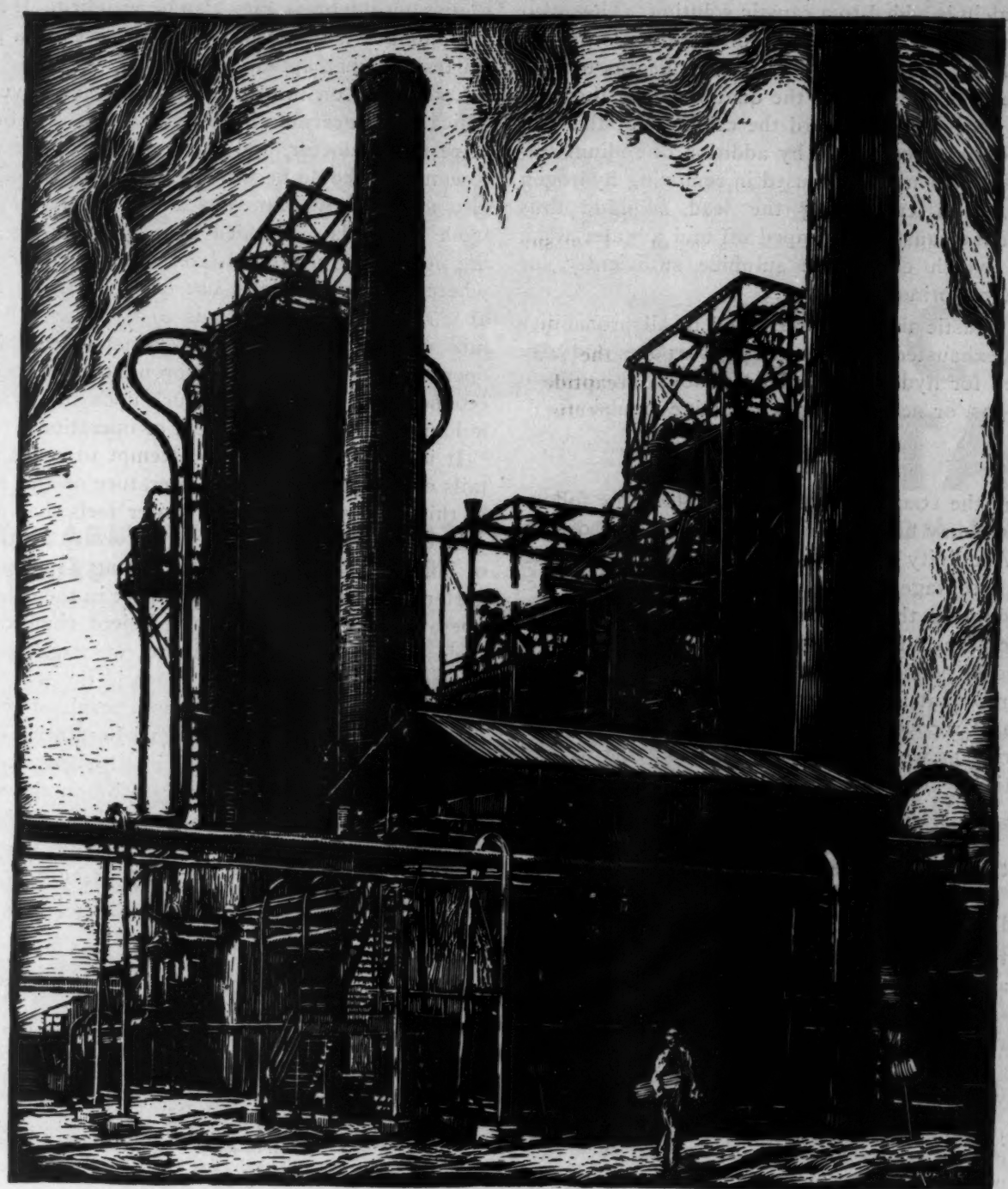
In checking up on the doctor reaction a sample of the treated oil is likewise used. If the oil is clear it is tested with doctor solution for sourness. If sweet, the fresh sample is given the copper strip test for free sulphur. Make sure that all caustic and cloudiness are first removed by filtering. If the strip is darkened it indicates excess sulphur. If there is no darkening the sample may be considered properly treated.

If the sample is not clear it is filtered. If it filters clear and passes the tests just outlined it is likewise considered alright and the portion which it was necessary to filter out will in all probability settle out, and if it does not settle out in a reasonable time it may be washed out with water. In the case of kerosene and heavy distillates hot water may be used for washing. If the sample does not filter clear it indicates lead mercaptide and the treatment requires more free sulphur. This may be added to the sample till it precipitates, then filter and test for sourness. If the cleared sample is still sour it indicates the need of more lead in the doctor. This may be confirmed by taking a sample of the doctor and test it by adding sodium sulphide solution. A black precipitate indicates lead is still present. The amount corresponding in a general way to the amount of precipitate shown in the test.

Oil containing only a small amount of mercaptan sourness is more difficult to handle in a continuous system than one containing a larger amount because of the delicacy of adjustment required in adding sulphur in order to avoid cloudiness and emulsions on the one hand, and a bad copper strip test on the other. A peculiar variation of the above rules may also occur in this case, where a clear sample may show sourness, though other tests show that the doctor has plenty of lead, and the answer may be found in the use of a little too much sulphur, precipitating the lead mercaptide and settling the doctor out of the oil before it has had time to react completely on the mercaptan. The difficulty is overcome by reducing the sulphur to a point where the settling does not take place for several minutes, or even a half hour, in a sample set aside for observation. It is usually found that settling takes place more rapidly in a treating tower than in a sample bottle.

RECLAIM DOCTOR

Most modern treating systems include a system of recovering lead sulphide and restoring it to solution in doctor. The usual method is to heat the doctor with closed steam coils while blowing it with air. Morrell and Faragher explain this as taking place in two stages. The lead is first oxidized to the sulphate, and this reacts with the caustic soda to form the plumbite which is the active agent in doctor. In designing air mixers for this operation we need to understand first of all that aeration is the principal aim rather than agitation. Small bubbles of air rising slowly give better aeration than large bubbles which rise rapidly and cause rolling of the liquid. Doctor from straight run distillates may be restored almost indefinitely but that from cracked distillates turns red due to the formation of chrom-



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ophoric groups similar to that produced when phenolphthalein is added to a caustic solution. They also accumulate cresols and other oily materials having emulsifying tendencies till the doctor begins to give trouble in settling out of the distillates. It then becomes necessary to discard the caustic, but the lead may be first precipitated by addition of sodium sulphide from spent caustic used in removing hydrogen sulphide. After settling the lead sulphide thus formed the caustic is pumped off and a water wash added, which cleans the sulphide sufficiently for further restoring.

The caustic thus discarded will in all probability not be exhausted for neutralizing purposes and may be used for hydrogen sulphide removal either from oil or gas, or neutralizing acid sludge emulsions.

TESTING

From the standpoint of the laboratory the following tests may be made a part of the routine of control: Alkalinity tests on caustic solutions to determine percentages of Na_2S, $NaHS$, $NaOH$, Na_2CO_3, etc., depending on the particular use being made of the caustic. Tests for lead in doctor, which may be expressed in pounds per gallon and reported to operators and plant foremen so that they may follow the course of recovery, and perhaps use in monthly inventories, as well as for knowledge to assist in daily operations. In some cases it may be necessary to watch the accumulation of SO_4 in caustic which is being used continuously in restoring lead sulphide. Results of sulphur tests on treated and untreated stock may occasionally be of interest to operators, as well as all check tests on corrosion.

Distillates which are rerun vary in the finished state according to the methods used in treating. An excess of sulphur in treating steam still stock will appear as hydrogen sulphide in the finished gasoline, and in extreme cases may come over as free sulphur. It may not, however, be possible to treat to an absolutely clean strip test on this stock and get good results in lead recovery on the doctor. In such cases the finished stock becomes the criterion.

Occasionally tests may be made to determine the amount of litharge and sulphur required on a given stock on a small sample as a check against plant operations. For this, a measured amount of distillate is treated with a measured amount of doctor, which is tested for amount of lead in solution before and after treating, the difference being in the PbS precipitated. The amount of free sulphur required to just get the break may also be weighed. If hydrogen sulphide is first removed, this serves as a practical test for mercaptan sourness.

Color tests on finished stock may also give some indication concerning how long caustic may be used in restoring doctor, and the tendency of the doctor to emulsify should be watched. The laboratory may also assist in working out a flow chart by which fresh materials are added by way of stocks which are not to be rerun, and later used on other stocks where specifications are not quite so rigid; and at at a rate which corresponds to the rate of loss, or final disposal, so that a fairly constant condition of operation is maintained throughout. Maximum economy often depends as much upon this systematic handling as any other item of operation.

It is perhaps needless to attempt to cover all details of operation, or all the literature on this subject in this brief space, but the writer feels that a great deal of conscientious effort is necessary on the part of both the laboratory and operating department to better understand each other's part in the scheme of operation which gives most efficient chemical control. As a sort of a look ahead, we might say that the next few years promise much in the way of new knowledge along these lines as a result of research, much of which will come from laboratories of pure science, such as educational institutions, and it is the business of the laboratory to be on the alert to reduce this to practice; and it is likewise the business of the operator to know more of the underlying principles of his work so that he may follow his daily routine intelligently.

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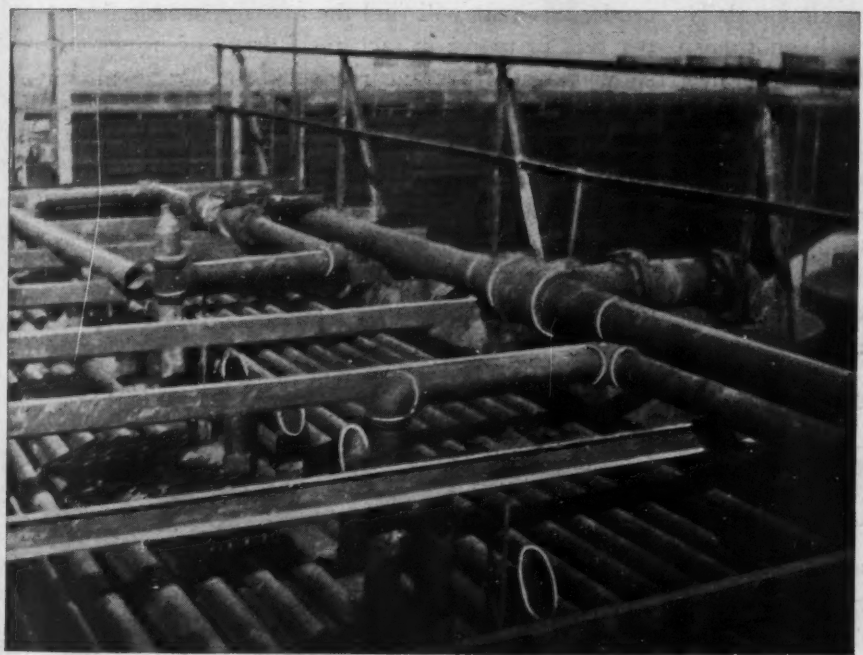

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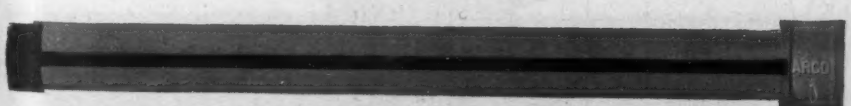

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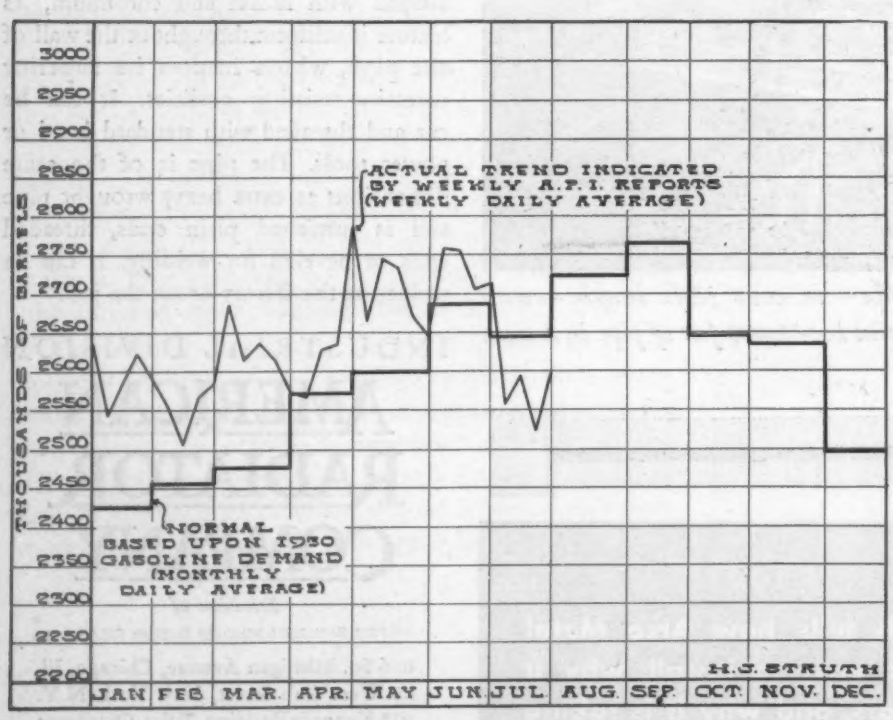
Still Runs Should Not Exceed 2,570,000 Barrels Daily

By H. J. STRUTH
Staff Economist

RECENT reductions in still run schedules in various sections of the country have brought the daily average down to a point indicated as representing the maximum conducive to economic stability. A study of the situation reveals that excessive runs during the first half of this year will make it imperative for the refining industry to limit daily average runs for the balance of this year to a maximum daily average of 2,570,000 barrels. Under normal conditions, it would have been necessary for the industry to utilize between 2,723,000 and 2,765,000 barrels of crude daily during August and September, but over-production thus far in the year and subsequent top-heavy stocks of gasoline offer no other alternative but to bring down and hold daily, still runs at the maximum figure prescribed throughout the balance of this year.

A careful survey of gasoline demand for the first half of this year and probable requirements over the piled by the writer to the effect that this year's gasoline demand would not exceed a nine per cent increase over last year. It is apparent, however, that increased cracking facilities have succeeded in increasing the percentage of recovery of gasoline from crude by an average of 1½ per cent over the preliminary estimate. Thus, instead of an average yield of 40 per cent gasoline from crude, this year will find the average increased to 41½ per cent or more; in fact, the Bureau of Mines figures show that the average recovery during the month of May was actually 42 per cent from crude. Under this line-up, it becomes necessary to effect a downward revision in still run schedules. Instead of considering a total crude throughput of 980,000,000 barrels the quantity necessary to supply this year's gasoline demand, it is necessary to revise that figure to only 947,000,000 barrels, or a daily average for the year of 2,595,000 barrels.



Revised refining run schedule for 1930. Weekly runs reported by A. P. I. corrected to conform approximately with Bureau of Mines monthly reports

ECONOMIC LIMITS PRESCRIBED

Table 1 shows the status of the refinery still runs situation by major refining areas of the United States, showing the total revised quantity of crude normally required, the amount actually consumed during the first five months of this year and the amount required during the balance of the year. It will be noted that the economic limit prescribed for the various refining districts during the balance of this year rather closely approximate the actual still runs indicated as of July greatest margin between normal and actual runs; the indicated excess as of July 12 amounting to about 18,000 barrels daily. Practically all of the other districts show a fairly close conformity with normal. The fact that runs have shown further decline since

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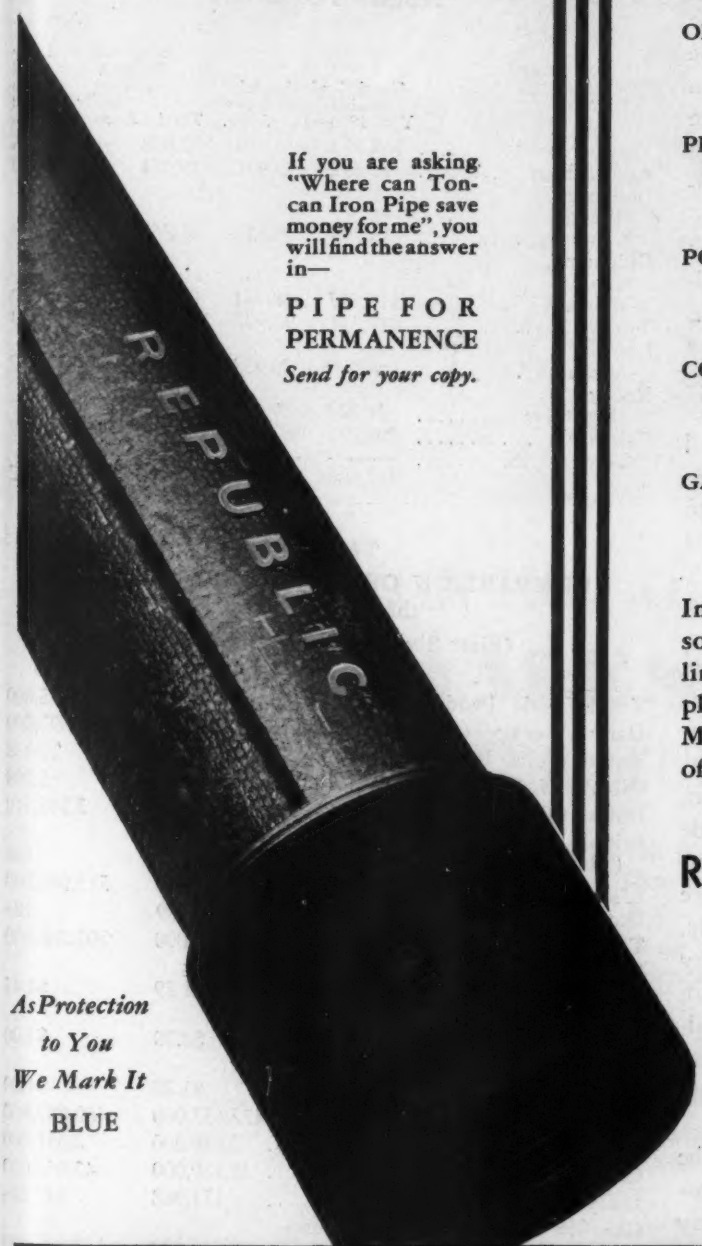

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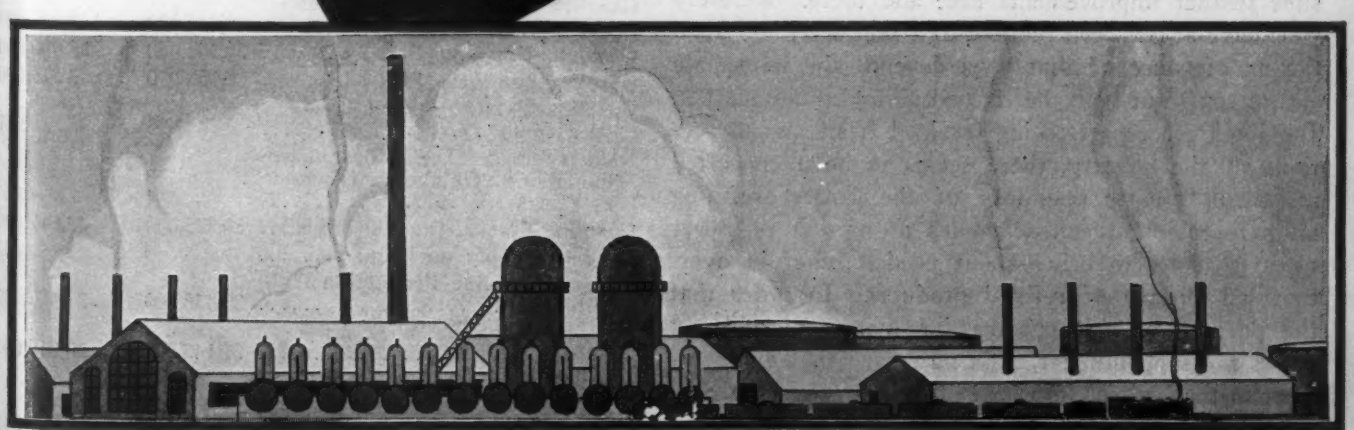


that date marks a decided improvement in the refinery situation for the present. However, it is apparent that the industry must attempt to hold still runs at their present level throughout the balance of this year if any material improvement is to be witnessed in the general refined oil market.

The accompanying chart, revised to take into account the utilization of less crude through the advent of increased recovery of gasoline therefrom, shows the status of refinery still runs of all refineries in the United States since the beginning of this year. In comparison with the normal limits prescribed by the demand for gasoline, it is evident that daily average runs for the first 26 weeks of this year have been considerably out of line. It is this abnormal rate of consumption during that period that makes it imperative for the refining industry to eliminate the excess product accumulated since January 1, by maintaining runs somewhat below current normal requirements. If the proposed schedule had been carried out during the first 26 weeks of this year, daily average runs to stills during August and September could have been maintained at from 2,720,000 to 2,765,000 barrels, whereas it now becomes necessary to reduce the economic limit to 2,570,000 barrels, or about 180,000 barrels below the indicated normal market demand.

REFINERY PICTURE UNFAVORABLE

A comparison of pertinent facts on the petroleum situation, as shown in Table 2, presents a rather unfavorable picture for the first half of this year. Particularly are the facts concerning the refining industry disparaging to the general oil market. Over-production, as a result of running excessive quantities of crude through stills, has been mainly responsible for the unfavorable comparison shown here. How this picture will look by the end of the year depends, primarily, upon the ability of the refining branch of the industry to maintain still run schedules at the level prescribed. If runs are pegged at about present levels for the balance of the year, there is every reason to believe that the annual report will make a decidedly better showing than that which accompanies this article.

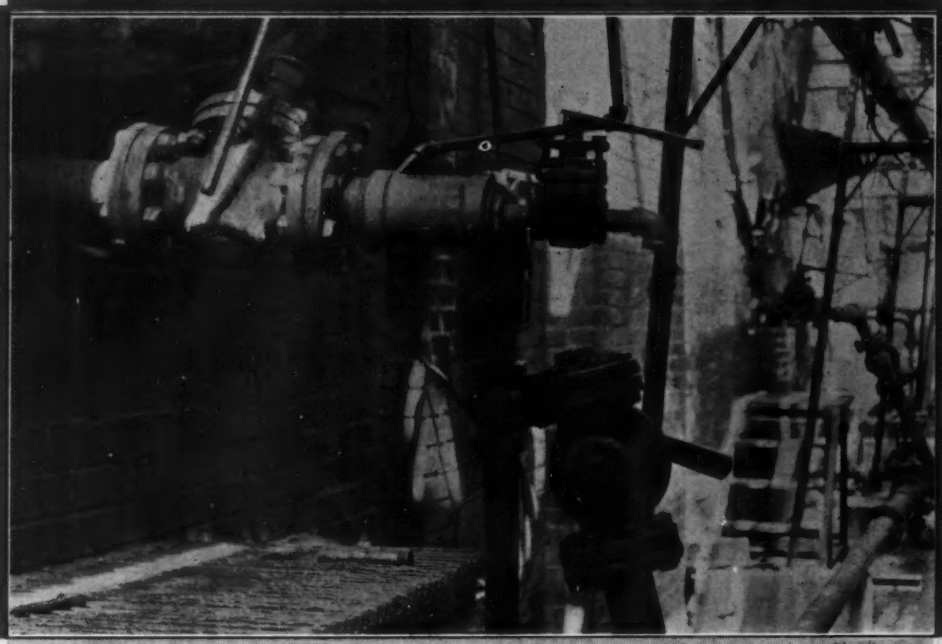
Crude production will undoubtedly continue to be held in check during the balance of this year, with possible further improvements here and there. Refinery runs have at last been reduced to a sane level and upon the maintenance of that level depends the immediate future course of both the refined oil and crude market. Judging from reports being received from various sections of the country, there seems to be a concerted movement among operators of the largest refining units to maintain run schedules at present or lower rates in order to bring about needed relief in overcrowded storage of refined products. In order that the purpose of this constructive movement will not prove a disappointment, it is necessary that every refiner in the United States give this matter earnest consideration and confine operations to actual day-to-day market requirements. If a majority of refiners pledge themselves to such a program throughout the balance of this year, improvement in the economic structure of the industry is bound to be the result.

TABLE 1
REFINERY CRUDE REQUIREMENTS
1930
Thousands of Barrels

	Total Crude Needed Year 1930	Actual Still Runs 1 st 5 Mo.	Required Balance of 1930 Total	Required Balance of 1930 Daily Average	Approximate Daily Still Runs July 12 1930
East Coast	168,492	70,619	97,873	457	475
Appalachian	33,382	13,991	19,391	90	90
Indiana, Illinois, Kentucky	115,799	48,534	67,265	314	319
Oklahoma, Kansas, Missouri	115,577	48,441	67,136	314	310
Texas	219,331	91,927	127,404	595	603
Louisiana, Arkansas	64,320	26,958	37,362	175	182
Rocky Mountains	21,824	9,147	12,677	59	67
California	208,275	87,293	120,982	565	577
Total U. S.	947,000	396,910	550,090	2570	2622

TABLE 2
COMPARISON OF PERTINENT FACTS on the Oil Situation
(First Six Months, 1929 and 1930)

	1930	1929
Total Crude Production (Bbls.)	465,128,000	488,115,000
Daily Average (Bbls.)	2,570,000	2,697,000
Total Wells Drilled	10,218	10,438
Oil Wells Completed	5,835	5,798
Initial Oil Production (Bbls.)	4,336,419	3,745,410
Initial Production per Well (Bbls.)	743	646
Crude Stocks July 1 (Bbls.)	524,143,000	515,990,000
Days' Supply on hand	189	185
Total Crude Demand (Bbls.)	501,054,000	505,368,000
Price of Oklahoma Crude—36 to 39.6 Gr. (August 1)	$1.29	$1.45
Price of Pennsylvania Crude—Nat'l Transit (August 1)	$2.20	$4.00
Price of California Crude—Long Beach, 26 Gr. (August 1)	$1.28	$1.09
Crude Run by Refineries (Bbls.)	477,657,000	480,843,000
Daily Average (Bbls.)	2,639,000	2,657,000
Crude Imported (Bbls.)	31,130,000	43,852,000
Daily Average (Bbls.)	171,988	242,276
Gasoline Consumption—Domestic (Bbls.)	190,217,000	174,329,000
Gasoline Exports (Bbls.)	34,165,000	28,996,000
Gasoline Imports (Bbls.)	8,158,000	3,515,000
Gasoline Recovery from Crude (per cent)	42.3	39.1
Refinery Price U. S. Motor Gasoline F.O.B. Oklahoma (August 1) (Cents)	6½	8⅝
Gasoline Stocks, June 30 (Bbls.)	50,225,000	42,017,000
Days of Supply on Hand	40	37
Natural Gasoline Production (Bbls.)	26,438,000	24,900,000
Natural Gasoline Utilization (Bbls.)	21,143,000	20,812,000
Price of Grade "A" Natural Gasoline F.O.B. Oklahoma (cents per gal.)	4¾	6¾



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You can make money because good market price, low raw material cost and low cracking cost spell profits

You can go on making profits without fear of interruption, because Universal Oil Products

Company guarantees you without limit against any loss arising from patent litigation

The Dubbs process means profits and security to you

What more can a refiner ask?

Universal Oil Products Co
Chicago, Illinois

Dubbs Cracking Process
Owner and Licensor

West Texas Operating Problems Solved

IN outward appearances equipment used in processing West Texas crudes could be duplicated in most any modern refinery. The accessories added to combat corrosion and erosion are not found elsewhere. In most of West Texas, even the water presents special problems, that requires special equipment.

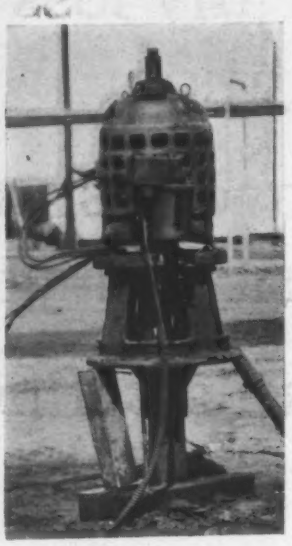

FIGURE 1

Richardson Refining Company recently celebrated its first anniversary at its refinery in Big Spring, Texas. This active city is half way between Fort Worth and El Paso, on the Texas & Pacific railway and also on Highway No. 1. During this year the executive personnel of the refinery have overcome most of the mechanical and operating tribulations. Superintendent C. B. Faught and his assistant, J. C. Moore, have directed the operations and research program.

The plant has a Foster-Wheeler crude pipe still with a topping capacity of 10,000 barrels and will produce an asphalt stock at 5000 barrels throughout. Two of the latest type 5-A Jenkins stills crack the gas oil produced on the pipe still. A 2500-barrel Graver rerun still has been added to rerun the acid treated distillate to produce U. S. motor gasoline.

One of the major problems encountered was supplying the plant with water. The sub-surface water beneath the refinery is fairly alkaline, suitable for condensing purposes, but boiler water is piped from another strata a mile distant. Most wells in this country are small producers. Pumps driven with motors as shown in Figure 1, are usually used, as most of these wells produce around 150 gallons per minute.

As West Texas is known for its dry climate, ideal cooling conditions prevail. Water from processing is readily cooled to 70° to 75° F. A 2500 gallon per minute Braun cooling tower, with the new slotted type louvers was erected over a 30,000-gallon concrete basin as shown in Figure 2. Circulating water is picked up in this small basin and pumped over the plant. The natural lay of the land permits the use of a concrete flume to return water from all the processing to a 1,000,000-gallon concrete basin. The flume was designed to handle 3500 gallons of water per minute. The water from the plant is spilled in one corner of the basin and picked up in the extreme corner by the cooling tower pumps. This gives a natural cooling of 10°. Figures 3 and 4 picture the water system.

Designed to utilize electrical power wherever possible, with steam standby on all pumps, in case of power failure, additions to the refinery soon taxed the boiler capacity. This was alleviated when the boiler feed water pre-heater shown in Figure 5 was built. This small pipe still feeds water into the boilers at 220° F. Most of the heat is obtained from excess gas produced on the Jenkins stills.

STREAMS WATER WASHED

Special equipment to combat the corrosion and erosion caused by salts in the crude and by the large quantities of hydrogen sulfide also present, are shown in Figures 6 and 7. The former pictures two small tanks through which gasoline from the crude still flows after leaving the condenser boxes. Cold water is pumped into the vapor line just at the point of entry into the box. The first of the two tanks collects most of the water and is pumped into the vapor line again until spent. The second tank catches the small amount of water carried over. Reflux is also taken from the second small tank.

Figure 7 pictures the lime mixing tank. A portion

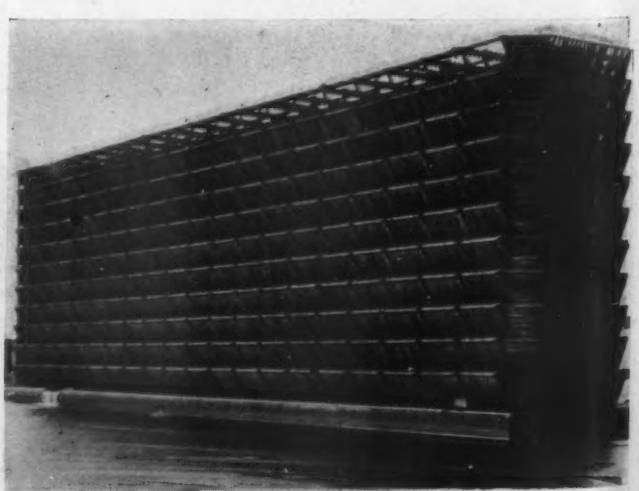

FIGURE 2

EXPERIENCE is the most important factor in design of modern refinery equipment.

We have the accumulated experience of many years as the foremost builders of fractional distillation equipment.

We have unquestionably constructed a larger variety of successful types of petroleum refinery equipment than any other concern in this field, and the knowledge thus gained is invaluable.

Various systems originated by us are accepted today as standards by the refining industry.

Most of the largest refiners have complete plants designed and erected by us.

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Sinclair Refining Co.
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Shell Petroleum Corp.
Phillips Petroleum Co.
Standard Oil Co. of N. J.
Empire Oil & Refining Co.
Texas Pacific Coal & Oil Co.
Associated Oil Co.
Pennzoil Company
Independent Refining Co.
Gulf Refining Co.
Tidal Refining Co.
Continental Oil Co.
Anglo-Mexican Petroleum Co. Ltd.
Cities Service Refining Co.
Barnsdall Corporation
Beacon Oil Company
Pierce Petroleum Corp.
Magnolia Petroleum Co. of Texas
New Orleans Refining Co.
Skelly Oil Co.
General Petroleum Corp.
Shell Oil Company
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Richfield Oil Co.
Humble Oil & Refining Co.

SONS COMPANY

TULSA HOUSTON BOSTON

FIGURE 3

FIGURE 4

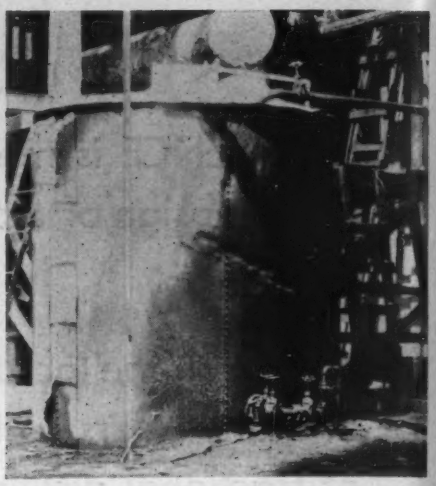


FIGURE 7

of the gas oil stream is admitted into the tank at intervals of eight hours. A definite quantity of lime is added and agitated with air. This mix is pumped into the suction of the crude charging pump in predetermined amounts by the small Hills McCanna pump at the right of the tank. The addition of this lime has added many months to the life of the equipment. During the entire period of operation none of the tubes in the pipe stills or cracking still has been replaced. This is also true of the vapor lines. However, the vapor lines on the Jenkins stills require changing approximately every eight months. These cracking stills have not been in operation during the entire year.

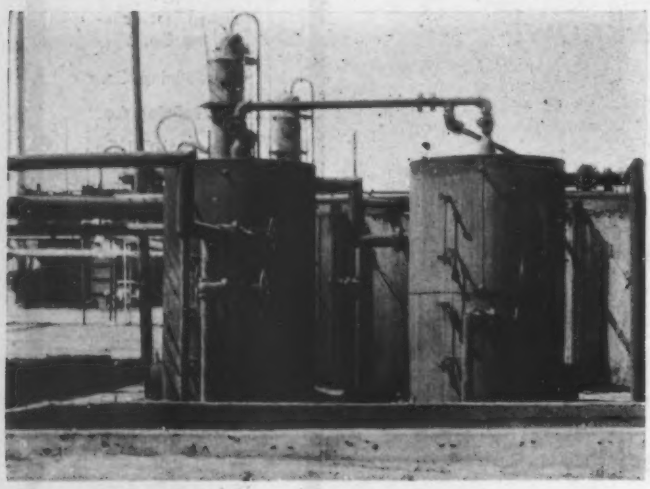


FIGURE 5

It has been the practice at this plant to have this lime which is calculated at .25 pounds per barrel of crude charged, added continuously. Hourly gauges are recorded from the lime tank so that a known amount actually is added. Without the addition of the lime, tubes and vapor lines are eaten away in only a few months, runs are shortened and the life of the equipment reduced very materially.

The addition of lime in the Jenkins stills produces a quantity of coke and undigested lime particles in the residue. The fuel is freed of this material by passing through the settlers at the rear of the units. Disposition of this waste material was a problem until the wagons shown in Figure 8 were built from the chassis of old automobiles. A couple of large horses are used, one on each shift to haul this refuse to the dumping pit. Two eight-hour shifts are necessary to keep the wagons dumped.

These fuel settlers are the "business end" of the Jenkins units. Extreme care is required in drawing down the accumulations and in cutting the still through the settler after a clean out, as an accumulation of water from steaming out, if allowed to enter the hot settlers, will cause a violent explosion.

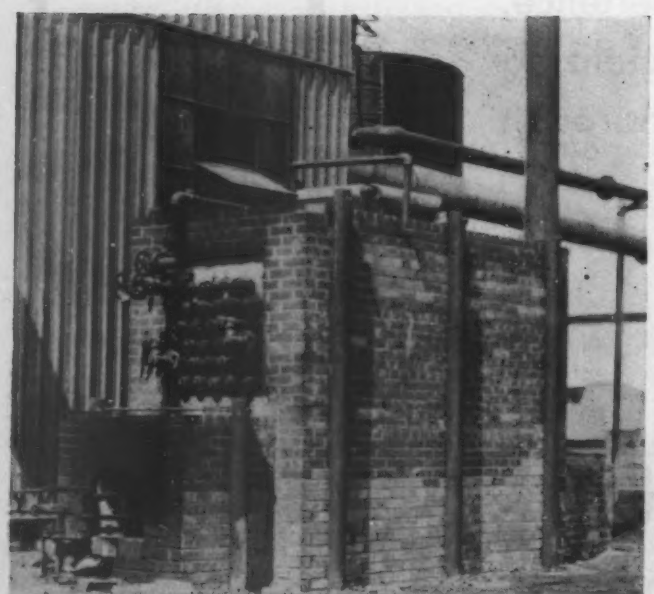
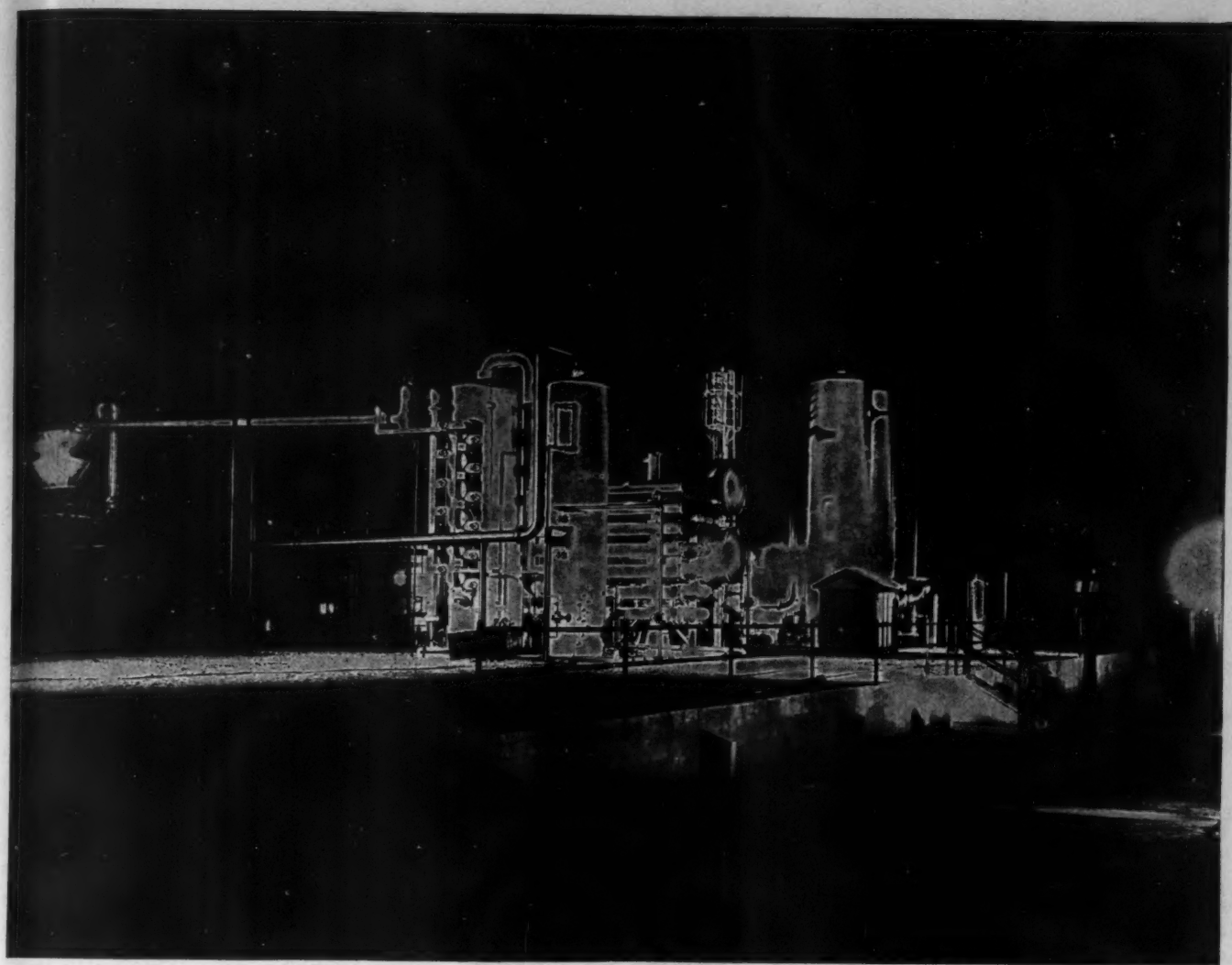


FIGURE 6

FIGURE 8



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NATURAL GASOLINE PLANTS TANKS REFINING EQUIPMENT

Methods of Utilizing Petroleum Residuals and By-Products

Paper presented before the Second Plenary World Power Conference, Berlin, Germany, June 16-30, 1390

By DR. A. E. DUNSTAN[1]
Institute of Petroleum Technologists

THIS is not a general refinery by-product and is obviously entirely dependent on the nature of the crude used.

Asphaltic petroleum residue of good quality is normally regarded as a valuable petroleum product and for road-making purposes it invariably commands a higher price than that obtained for fuel oil Again for other more specialized purposes such as waterproofing, electrical insulation and the manufacture of roofing felt, good prices can be obtained. Where however the asphaltic residue produced is not considered suitable for the present known applications, this relatively valuable material must of necessity be regarded as a refinery by-product, and unless it is suitable for the production of heavy lubricating oils, its only use is as a low class boiler fuel. On the other hand, many asphaltic residues unsuitable for road construction, etc., could in any case only be regarded as by-products. Their unsuitability for road purposes may be due to a variety of causes such as excessive hardness, too high a percentage of paraffin wax causing a deficiency in ductility, incorrect relationship between the constituents of the asphalt, etc.

DR. A. E. DUNSTAN
Chief Chemist Anglo-Persian Oil Company

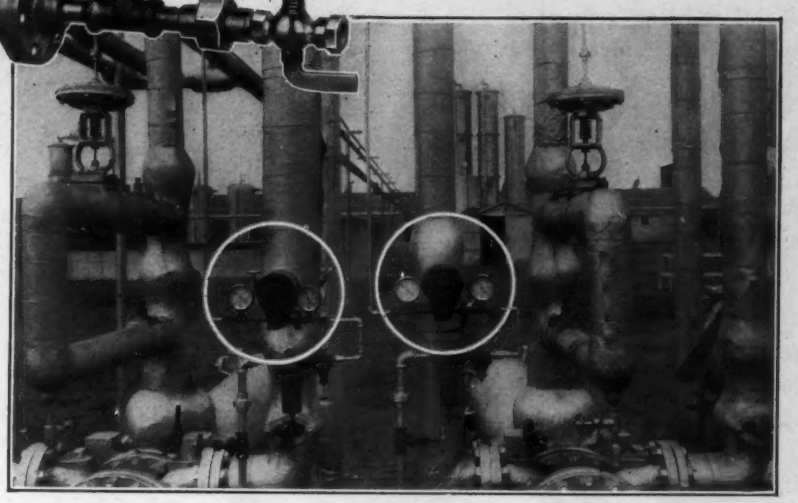
THIS is the second installment of Dr. Dunstan's paper on utilization of petroleum residuals and by-products. The first section, which appeared in July (page 125 et sec), deals with acid sludge.

The combustion of asphalt under boilers and in furnaces is a matter requiring a certain amount of forethought and extra expense, but providing that precautions for maintaining the material in a liquid form and for utilizing a suitable firebox are taken, the problem presents no unsurmountable difficulties. In many refineries, asphalt is being burnt under boilers and cracking plants, but usually a parallel liquid fuel burning system is provided as a "stand by." Asphalts of melting points up to 80° C. (176° F.) have been burnt successfully without cutting them back with liquid fuel, and it is probably that material of even higher melting point could be burnt using specialized apparatus. In one type of plant brought to the authors' notice the heated liquid asphalt was circulated through a ring line from which the burners were supplied. The ring line was fitted internally with an asphalt heater of the tubular type, the first part of it with branch lines to the burner being three inches in diameter. The ring line was then reduced to 2½ inches and later to two inches, and was supplied with various expansion bends. The branch lines were constructed of extra heavy copper tubing. Two circulating pumps in duplicate were provided and in the event of a breakdown on both pumps, the system could be flushed out by means of the pumps of the fuel oil system.

When burning high melting point material it was stated that a rather heavy deposit of coke formed on the furnace floors and caused irregular firing. This was due to the combustion space being too small, but by deepening the furnaces to about one foot eight inches below the center of the burners, a considerable improvement was obtained, so much so indeed that it was found unnecessary to use compressed air to accelerate combustion as had been done previously. Coking of the tips of the burners occurred to a greater extent than when fuel oil was used, but this trouble was not considered to be serious. The asphalt was heated to about 300° C. (572° F.) in the heater and returned to the tank with a temperature of approximately 200°C. (392°F.), the discharge pressure being about 11 atmosphere.

Where coal fines or low quality coal slack is available certain types of asphaltic residue can be used as a binder to form the powdery material into briquettes. Owing to the relatively high calorific value of the

[1]Anglo-Persian Oil Company.



Simple Fool-Proof Design *. and .* "Trouble-Free" Operation *feature* BRISTOL'S

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ABOVE are shown two Bristol's Air Operated Temperature Controllers installed at one of the larger Natural Gasoline plants in the Greater Seminole Area of the Mid-Continent field. These particular instruments are used to automatically control pre-heater temperatures, thus insuring a constant temperature of gasoline entering the stabilizer column.

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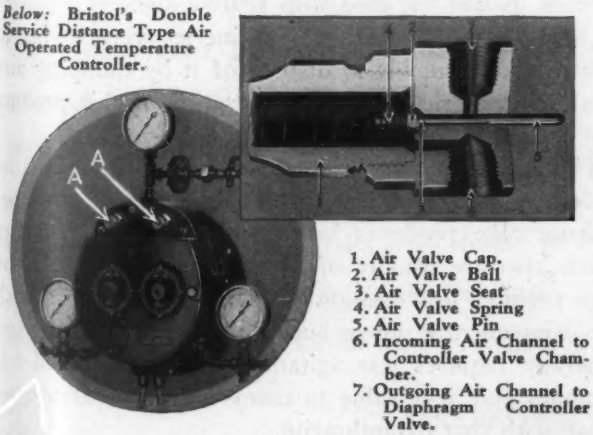
Those responsible for instrument operation and maintenance will immediately appreciate the rugged, durable construction, and simple design of all operating parts in this Bristol's Controller. Especially as such design pertains to the controller air valve (see detailed descriptions elsewhere on this page).

Complete information, prices, etc., will be sent to any interested person in your plant. Get in touch with nearest Bristol's Branch Office or write direct to home office at Waterbury, Connecticut.

Sectional view shows simple trouble-free design of Air Valve in Bristol's Controllers

Below: Bristol's Double Service Distance Type Air Operated Temperature Controller.



1. Air Valve Cap.
2. Air Valve Ball
3. Air Valve Seat
4. Air Valve Spring
5. Air Valve Pin
6. Incoming Air Channel to Controller Valve Chamber.
7. Outgoing Air Channel to Diaphragm Controller Valve.

A distinctive feature which has done much to establish the fine record of Bristol's Air Operated Controllers is the simple design, rugged construction and accessibility of the Controller Air Valve. As shown above at (AA), the Controller Air Valve Cap extends thru front of instrument case; readily accessible for inspection, cleaning, replacement or interchanging.

To remove, unscrew air valve cap (A or A) and lift out air valve (2) with spring (4) attached. The Valve seat (3) is then exposed, almost flush with front of instrument case.

To replace, simply screw Valve Cap (1) into position again. The Controller is immediately ready to operate—no further adjustments are necessary. In fact, no adjustment is required regardless of length of time instrument remains in service.

Complete control equipment can be furnished to automatically regulate either temperature or pressure . . . temperatures up to 550° Fahr., or pressure to 500 lbs. per square inch.

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BRISTOL'S

asphalt addition the resultant solid fuel compares very favorably with high grade coal as regards heat value, but in the case of the coal slack briquettes, their relatively high ash content is in many cases a definite drawback.

It will be realized therefore that asphaltic residues although not being by any means an ideal liquid fuel can at times be used to considerable advantage particularly where storage space for asphaltic materials is limited and where the whole throughout of a given crude oil is being refined to give a complete range of fully refined products—e. g. motor spirit to lubricating oils.

PETROLEUM COKE

Petroleum coke is a waste product from the destructive distillation of petroleum products at temperature above their decomposition temperature. It is in appearance very varied ranging from a dirty sooty dust, fines, cakes to normal coke appearance.

Proximate Analysis—	Petroleum Coke Per cent	Anthracite Coal Per cent	Bituminous Coal Per cent	Lignite Per cent
Moisture	1.40	2.9	2.9	37.1
Volatiles	12.03	4.5	34.3	26.9
Fixed Carbon	85.84	79.0	55.6	26.9
Ash	0.84	11.6	5.8	7.8
B.t.u./lbs.	15,293	12,485	13,630	6,500

The extremely low ash content of petroleum coke will be readily noticed and this is a large advantage when considering the question of residue.

It is far superior in thermal value and is low in volatiles, this is important as it indicates the smoke producing qualities.

These properties indicate its use as a domestic and general fuel. Unfortunately as produced from the still it offers many transport and utilization difficulties due to its large content of powdery matter and general friability.

There are several processes for briquetting it but these will be dealt with later.

PRODUCTION SOURCES

The last decade has seen the rise of the cracking and coking industries. Petroleum coke is produced from both these processes in large quantities and the vast expansion of these industries has increased the production of this by-product to a very great extent. Last year about one million tons were produced in the U. S. A.

CRACKING

In the early part of this century the most important light fraction from petroleum was kerosene used for burning and illuminating purposes. The advent of the motor car brought a new product rapidly to the fore, i.e. motor spirit. The rapid development of the automobile industry soon changed the position and in a few years motor spirit was the largest and most paying product from petroleum.

The development of the car caused greater demand for spirit, the increase in the efficiency of cars led to more and more exacting standards for petrol.

The refiner till a period ending just after the recent war could meet his gasoline requirements quite easily from his crude production. The demand however for gasoline rose to such an extent that the refiner was faced with another problem. Either he must increase his production of crude above his necessary figure for meeting markets with the heavier distillates or he must endeavor to increase his yield of gasoline from his normal refining method. On the straight forward distillation process up to then in use he was obtaining round about 17 to 20 per cent of his crude as a motor spirit. Excess production of crude to enable him to meet the greater demand for gasoline would in a very short while have meant impossible storage conditions.

The markets unfortunately for the heavier fractions had increased in nothing like the same proportion to that of the lighter. What was therefore more natural than he should endeavor to obtain an increased yield of lighter distillates than he was then obtaining.

Research therefore developed the cracking industry. This has resulted in the refiner being able to compete with the growing demand and the amount of spirit suitable for use as gasoline now obtained from the crude is around 35 per cent.

However the advantages of this process are to a certain extent offset by the fact that continued heating besides breaking down the molecular structure of the charge and so forming lighter distillates also produces polymerization, which is evidenced by deposition of the so-called petroleum coke usually a hard porous shining substance composed probably of hydrocarbons of high molecular weight of polyclic form and usually low in hydrogen content.

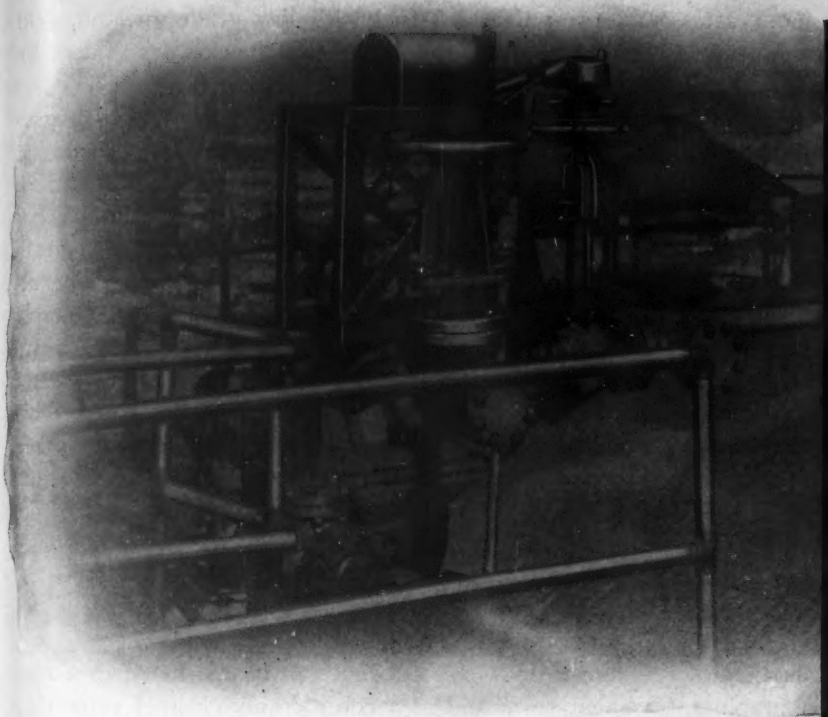
UTILIZATION OF PETROLEUM COKE

In the majority of refineries no immediate use for the coke could be found it was therefore dumped and there arose again the question of storage space, almost acreage, as was the case with acid sludge.

Quite a large percentage of refineries were, owing to lack of space, unable to dispose of it by dumping and it is their experiences in the utilization of this product that is of particular interest.

The most important use yet found is as its use as an ashless, almost smokeless, rich fuel. A ton of good petroleum coke produces less than 20 pounds of ashes which also are usually of non-clinkering nature. The coke requires less draught than ordinary coke or coal, it is consequently slower burning, more economical and generally requires less agitation. These manifold advantages give it a value to many industries almost on a par with that of anthracite.

Against these advantages it must be stated that the transportation of the coke is not usually an easy matter. On production it has a very large content of fines and soot and the larger size coke has a tendency to turn very quickly to fines and dust, therefore, when lengthy transportation is necessary some form of treatment must be given it which raises the cost. Owing to its very small ash production it cannot be used alone for



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firing chain grates and stokers. The absence of the protective layer of ashes makes the heat on the grates much greater and under these circumstances the grates very quickly burn out. It is therefore necessary to mix the coke with coal, equal quantities of these two fuels is said to be roughly the economic limit, and in this proportion there is very little evolution of smoke.

Generally however any kind of furnace, including those hand-fed, can utilize petroleum coke as a fuel provided there is a protective layer of bricks on the bars or grates.

It has been used in the smaller railroad engines in the southern United States with considerable success. Alterations to the design or layout of the fire boxes were negligible and running costs as compared with the fuel oil previously used were between 15 and 25 per cent lower.

There are a number of other minor uses for this coke. They are minor only in respect to quantity as the products they produce usually obtain a considerably higher price than would the coke itself if used as fuel. These uses which include the production of almost pure carbon for the production of graphite, electrodes, crucibles, pencils, dry cell batteries, briquettes, etc., are governed entirely by the nature of the coke produced.

There has so far been mentioned only the cracking process as a source of petroleum coke production. There is however one other very large source of production and that is from the carbonization industry, as this is now a separate industry and is hardly a refinery by-product the utilization of the coke produced from this source will not be dealt with.

Quite early American manufacturers found use for this product from cracking processes as a fuel and when the refineries found there was a plentiful and growing demand in towns close to their refinery they naturally started to exploit the supplying towns remote from their installations more particularly those not in or near fuel producing areas.

The following table showing the consumption petroleum coke in detail for the year 1928 in America, indicates the relative importance of the various uses:

Type of Consumption—	Short tons
By petroleum refineries as fuel	550,000
As domestic fuel for house heating	220,000
As pulverized fuel in various industries	154,600
Shipments to foreign countries	144,100
Manufacture of electrodes and carbon products	105,200
Gas-making and generation of electric power	98,400
Lead and zinc smelters	25,800
Pigments, carbides, lime, etc.	19,600
Experiments and miscellaneous heating	6,500
Total	1,324,200

It will be noticed that the refineries consume over 40 per cent of the total consumption themselves. Some refineries burn this coke in an admixture with coal for heating stills, etc. others pulverize the coke then mix the pulverized fuel with low grade fuel oil, acid sludge, fuel oil etc. and burn it in closed furnaces by means of air oil burners, as has been described.

The second largest use is nominated as that of household heating. Here the nature of coke is of the utmost importance. The only type of petroleum coke suitable for this use is the larger normal coke like lumps, the fines and soots are of little use as on a normal grate this fuel would slip through the grate bars. The alternative is to provide a new type of fireplace suitable for its economical combustion until the quality nature and price of the coke have been firmly established and a plentiful and well distributed supply arranged. This appears of but little use. The question of price apart from the preceeding, will of course, be the deciding factor. At the moment, the prices ruling for coke in the United States is per ton

Lumps	$4.50 to $5.00
Still runs	$3.00
Breeze	$2.00

However if this product can be marketed in a convenient form and at a considerably cheaper price than coal with a good supply organization arranged then it is hard to see any reason why it should not be a success.

The refiner has to a point met the position half way by the production of coke briquettes from his unwanted production of fines and coke soots. This is an interesting development and will receive attention later.

Third on the consumption list is use as a pulverized fuel in various commercial industries.

The authors understand that the pulverized product is used in some brick plants in admixture with the clay to assist in the burning of the brick and to improve its color. The coke acts as a reducing agent to the metallic oxides in the clay without leaving any ash minerals in the brick as is the case when coal is used for the purpose.

It is also on record that it is being used in a big meat packing company. Fruit growers are using it for smudge fires as it has been found that it does not impair the quality and flavor of the fruit. Wireless manufacturers use it in the production of battery cells. Another use in the pulverized form is in foundrys for metal smelting and refining. Cement manufacturers find it of use as a fuel in the production of their product. It is stated that a ton of pulverized petroleum coke is sufficient to manufacture approximately 20 barrels of cement. Then again its use as a building heating fuel is obvious; on oil fired furnaces it can quite easily and profitably be used.

The authors have received advice on the stoking of a steamer in the East with low pressure cracking coke.

The analysis of the coke used was as follows:

Cal. Val. maximum	8920 cal.
Oil content, soluble in benzol	6.2 %
Sulphur	0.17 %
Ash	0.32%

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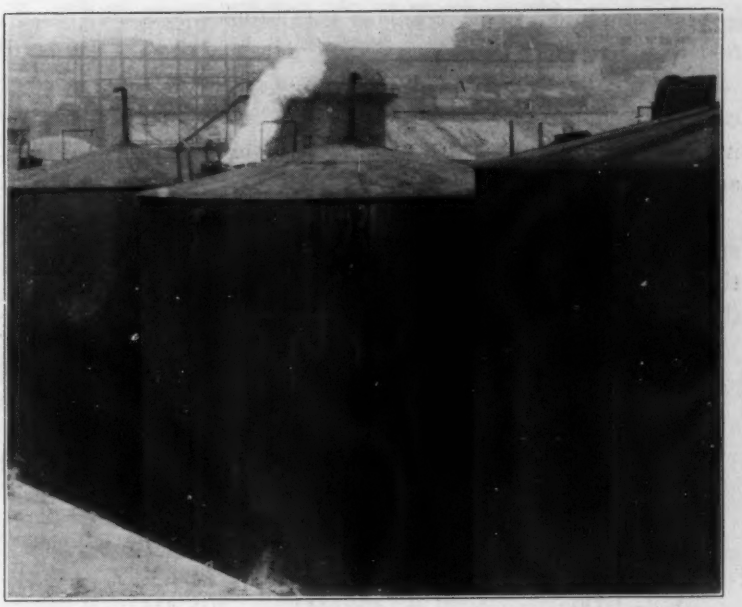

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Back of this familiar symbol is thirty years' experience in the manufacture of special analysis iron and steel sheets and plates. When you want a rust-resisting, low-cost metal be sure to see this triangle and the words, "Armco INGOT IRON." It is your assurance of dependable economical service.

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The coke used was damp, as it had been lying out of doors and about 50 per cent of it was in the form of coarse powder. It was dropped 12 feet into the bunkers; from which it suffered no harm. It was first used in a mixture with coal in the proportion of coal to coke = 3:2, the coal being of poor quality, with about 30 per cent ash. This gave satisfactory results. Later, a mixture of 2:3 parts of coal and six parts of coke, was used; this give satisfactory results, and later after running 24 hours on this mixture one of the furnaces was stoked with the coke only. The combustion was good, with medium fires. A small portion dropped unburned from the fire bars as these were one inch apart. This was put back on the fire again. Later, all furnaces were stoked with the coke. Combustion was good, with practically no smoke, giving plenty of steam. 1.85 lbs./i.h.p./h was used, in comparison with 2.35 lbs. /i.h.p./h for coal. The objection that coke takes up too much space as compared with coal, was therefore overcome by the higher combustion value of the coke. This particular steamer used about eight tons of the coke in 24 hours, in comparison with 11 tons of coal. On arrival at Singapore fire bar bearers were found to be in good condition. The steamer's staff were well satisfied with this coke.

Fifth on the list; the manufacture of electrodes and carbon products has already been mentioned and the increasing consumption in this line is due to high standard of carbon obtained.

Though these figures and remarks indicate that considerable progress is being made in the utilization of this by-product there is undoubtedly room for further utilization as the following figures will show:

	Coke Output Tons	Coke Stocks Tons
January 1928	103,200	331,300
April 1928	109,400	342,100
July 1928	127,000	384,900
October 1928	125,000	404,400
January 1929	137,900	403,800
April 1929	130,700	444,900
July 1929	157,900	563,900
September 1929	161,200	648,500
21 months increase	56.2%	95.7%

BRIQUETTES

As has been stated the refiner in order to find a market for the less marketable portion of the coke the fines and soot have in many cases solved it by the production of briquettes.

Many processes have been evolved for the formation of briquettes, they all however initially pulverize the coke to a very fine mesh, and then bind it by some low priced fuel such as tar etc.

One most interesting process of double value consists in the first place of crushing and then pulverizing the coke to 30 to 60 mesh. An electro magnet then takes out the metallic particles reducing subsequent wear on plant and making the product cleaner. The product is then mixed hot or cold with refinery acid sludge five to 10 per cent usually being the amount necessary. By this utilization of acid sludge another market is made for this also wasteful and troublesome product.

The coke and acid sludge are very thoroughly mixed and then fed to any form of briquetting press. A roll type press was selected producing small pillow shaped briquettes weighing three to four ounces. The product now in the form of a briquette would still not stand up to anything in the way of rough treatment. It is accordingly fed on to a conveyor and taken to a roaster or carbonizing furnace wherein a temperature of 450 to 110°F. (232 to 593°C.) is maintained according to the product desired.

In this furnace the briquettes receive sufficient heat to drive all or part of the volatile matter off, the sooty fine carbon is disposed of and the authors claim the product to be a clean metallic like coke structure. The process also includes for the collection of the volatile matter driven off and its use in the gaseous state as a heating medium for the carbonizing plant.

The authors further state that the briquettes on emission from the furnace are a finished product consisting substantially of pure carbon of exceptionally hard structure and capable of withstanding the most severe handling, yet possessing a sufficiency of volatile matter to enable ready ignition but not enough, however, to prevent the fuel being smokeless.

WASTE GASES

In the refining of petroleum a large quantity of gases are evolved which in the majority of refineries in the past have been looked upon as waste and have usually been burnt.

Various uses have now been found for this waste product.

In the first place it is in many cases passed through middle oils which absorb part of the gas. The oils are then heated and the absorbed gas is recovered as motor spirit or light distillate. The stripped gas is then passed to the stills and is used under suitable conditions as heating power.

Another use is the cracking of these gases to form various alcohols.

An entirely different type of waste gas is "natural gas." This is, of course, the gas which issues from petroleum wells.

The utilization of this product can only be effected in certain cases, i.e., when the refinery is very close to the actual producing wells and as this is frequently the case in America the matter is of certain interest.

There are two chief methods of utilizing this product.

The first is in the refinery as a fuel, the gas being conveyed by pipe line to the stills it is burned in closed furnaces through suitable burners.

The second use is as a commercial and domestic heating unit.

The last few years have seen an immense stride in America in this form of utilization. Miles of pipe line

Now They Use ARMSTRONG Traps—

Engineers who used cracked valves for years found that there is a foolproof steam trap

The No. 30 Armstrong trap meeting the demand for a small, efficient and inexpensive trap.

The No. 31 Armstrong trap —ideal for draining small steam heated units.

UNWILLING to risk ordinary steam traps, the engineers of one plant had used cracked valves for years to drain condensate from separators on steam lines to stills. The outstanding performance of Armstrong inverted bucket steam traps was called to their attention; they installed No. 30, 31 and Special traps as shown in the illustration; and their worries over slugs of water getting into stills ended.

Other large industries have standardized on Armstrongs—both for power and process steam using equipment. There are probably more Armstrongs in use than any other mechanically operated trap.

The features of Armstrong design that insure positive and attentionless condensate and air elimination are: no airbinding . . . . grease and sediment are discharged (the trap is self-scrubbing) . . . . small size with large capacity (no supports usually required) . . . . no steam leakage . . . . no wire - drawing. They are made and guaranteed by a company that has specialized exclusively on steam traps for 19 years.

90 DAYS FREE TRIAL! Because of their small size and successful performance, we are glad to send you as many Armstrong traps as desired for 90 days' test, without obligation to you. Return the traps collect afterwards. The coupon is for your convenience.

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Send the Coupon!

have been laid to supply most of the towns in the central and southern states. According to United States Bureau of Mines 1,568,139,000,000 feet of gas was produced and delivered to consumers in 1928. This figure incidentally is an increase of eight per cent over the previous year.

In the individual consumption, domestic consumers of which there over 4¼ million in the United States used 20 per cent at an average price of 60.8 cents per thousand feet.

Of the remainder, approximately half was used for industrial purposes while the other half found use in the fields and refineries.

Lastly, natural gas is also stripped to produce a light spirit which though very wild is used in admixture with normal motor spirit to give this last product a lower boiling range. The extent to which this industry has grown may be gauged by the fact that 200 million gallons were produced in the United States in October last.

The author desires to express his indebtedness to Mr. J. Kewley and Mr. L. G. M. Roberts for their assistance in collating the information in this paper.

Particular acknowledgement is made also to the following: Mr. J. Kewley, Dr. G. Egloff, Mr. J. B. Rather, Mr. L. W. Barbour, Mr. H. G. Osborn and Mr. L. L. Davies, Mr. L. M. Johnson and Mr. L. J. Farrell, Mr. J. C. Chatfield, Mr. W. H. Thomas.

Lime Distribution Plant to Combat Corrosion
(*Continued from page* 75)

taining kerosene. The ammonia passes over into the tower and rises with the gasoline vapors through the tower and into the gasoline condenser coils.

Periodic inspection of the tower and vapor lines, has been found to be of more help in proportioning the ammonia than testing overhead streams or running iron tests on the water coming over with the stream. The gas produced from running this Winkler crude is very poisonous containing about 10,000 grains of H_2S per 100 cubic feet of gas, and of course prevents any accurate testing of the stream for alkalinity or acidity. This gas, which amounts to about 120,000 cubic feet per day, is burned under the stills, as it would be too expensive to treat this gas sufficiently for it to be safely handled by the compressors.

The lime treating systems were designed and installed by Pure Oil Company engineers. It has the advantage of centralized control and operation. Much of the equipment was designed by A. L. Christy of the Chicago office. The plants have given practically no trouble and have done much toward reducing replacement of expensive equipment and gives much safe working conditions for employees engaged in process work.

The Hydrogenation of Mineral Oils
(*Continued from page* 81)

equilibrium constituents are light oils. Here it is well to mention that newly formed materials are in the most chemically active (nascent) state. Hydrogen, at its moment of release from combination, as in the cracking of natural gas or the electrolysis of water, is at its point of greatest activity, a freshly cracked oil is in a similar state of greatest activity. Under such conditions resynthesis into more stable compounds proceeds.

CARBON-HYDROGEN RATIO

Carbon seems able to exist in chemical combination with hydrogen in all ratios. The simplest ratio is that found in methane where four hydrogen atoms are combined with one carbon atom. The higher members of the series contain correspondingly less hydrogen to carbon, that of ethane being three to one. For the paraffin series C_nH_{2n+2} an inspection of the formula shows that this ratio can never be less than two hydrogens to one carbon. In the unsaturated series the ratio hydrogen to carbon is expressed by the general formula C_nH_{2n}, which also applied to the cyclic or naphthene series. Benzene has the formula C_nH_{2n-6}. The percentage by weight of each constituent is found by multiplying the number of carbons by 12 and the number of hydrogens by one. Combinations of the series are the rule rather than the exception. In crude oil, which is a mixture of paraffin, naphthene, asphalts and unknown series of hydrocarbons, the weight ratio of hydrogen to carbon is between one to six and one to eight. Commercial straight gasoline averages about one to 5.3. Benzene is one to 12. Cyclo-hexane C_6H_4 is a naphthene boiling about two degrees higher than benzene the ratio of hydrogen to carbon is one to six. It is evident from the above that any crude has more than sufficient hydrogen to convert all of the carbon quantitatively, into benzine or cyclo-hexane. However, such is not possible by cracking as there must be an excess of hydrogen to satisfy the conditions of equilibrium in which hydrogen, methane, ethane, ethylene, propylene, etc., all comparatively rich in hydrogen, must exist if gasoline exists as a recomposition product from heavier oil. Carbon monoxide under such conditions might prove a valuable aid in producing new conditions of equilibrium more favorable for the production of motor fuel.

The writer realizes that the foregoing discussion is very sketchy and general. The subject will be dealt with more specifically in a subsequent article. Hydrogenation can be nothing more than a modified and improved form of cracking, as whatever other conditions are involved, a lighter and more volatile oils results from the hydrogenesis.

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"CUTNO" retains its lubricant so that the shaft working against it is under constant lubrication.

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"PELRO" is designed to give long satisfactory service in pumps handling gasoline, naphtha and all other distillates of petroleum, and its compound is not affected by the severe action of these fluids.

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PLANT MEN AND METHODS

By GEORGE REID

LEADING refining companies of the United States have become holders of the shares of Hydro Patents Company, a Delaware corporation to which patents of the Standard-I. G. Company relating to hydrogenation of coal, oil and other hydrocarbon and carbonaceous materials have been transferred. The shares are held by 17 refining companies, with 500 shares as the minimum holding; which 17 organizations have a combined total refining capacity of 2,363,700 barrels per day and so represent 80 per cent of the refining capacity of this country.

This is evidence of the active interest in the hydrogenation process and indicates something of the possible adaptation of system by the industry. The hydrogenation process marks the first substantial move toward the application of the basic principles of chemical synthesis in the petroleum industry. Its advantage over cracking lies in the fact that it is a constructive, rather than a destructive process, and through the injection of hydrogen secures slightly more or less than 100 per cent conversion of the original oil into gasoline or other products of more value. Hydrogenation, in addition to its utilization of oil to the extent that it may all be converted to gasolines or lubricants as needed, has converted the coal and shale deposits of the world into practically unlimited reserves. Ten years of research has proven its adaptability.

The shares of Hydro Patents Company are held by the following United States refining interests: Atlantic Refining Company; Barnsdall Corporation; Cities Service Company; Continental Oil Company; Mid-Continent Petroleum Corporation; Sinclair Refining Company; Skelly Oil Company; Pure Oil Company; Shell Union Oil Company; Standard Oil Company of California; Standard Oil Company (Indiana); Standard Oil Company of New Jersey; Standard Oil Company of New York; Standard Oil Company of Ohio; The Texas Company; Union Oil Company of California and Vacuum Oil Company.

FRANK A. HOWARD, president of Standard-I. G. Company and vice-president of Standard Oil Development Company, heads the group of 12 executives who sailed for Germany on the Bremen July 16 to make an intensive study of the work being done on the hydrogenation process by the I. G. Farbenindustrie A. G. in that country. The party will be abroad about a month.

The group consists of Dr. H. M. Weir of Atlantic Refining Company; E. W. Isom, vice-president, Sinclair Refining Company; R. A. Halloran, Standard Oil Company of California; Dr. R. E. Wilson, development head of the Standard Oil Company (Indiana); and Wm. Plummer of the same company; Dr. J. B. Rather, Standard Oil Company of New York; S. J. Dickey, consulting engineer of General Petroleum Company; J. Stewart Harrison, vice-president in charge of manufacture for Standard Oil Company (Ohio); R. J. Dearborn and Michael Halpern of The Texas Company; A. G. Page, Union Oil Company of California, and Mr. Howard. Representatives of several other companies interested in the process will join the party in Germany.

This group represents the majority of the companies announced by Standard Oil Company of New Jersey as participating with them in Hydro Patents Company, the new company recently formed to take over the rights to the hydrogenation process in the United States. Their observations abroad are in accordance with plans to study the operation of the process both in Germany and in the Standard Oil Company's new hydrogenating plant now undergoing tests at its Bayway, New Jersey, refinery. The future application of the process by the individual companies forming Hydro patents will depend to a large extent upon the results of the present study.

BECAUSE certain high class Pennsylvania lubricating oils are red by transmitted light and a characteristic green by reflected light, which has led consumers to look for these accidental attributes in the oils they buy, perhaps it is only natural that producers of competitive lubes should seek to "improve" the appearance of their products without affecting the quality. Just what difference fluorescence makes in "lube," is difficult to answer, and just what additional expense is justified to secure color and sheen typical of Pennsylvania "lubes" or just why it should be imitated at all, are moot questions. At any rate several companies have done a great deal of work in securing a green bloom.

Royal Dutch chemists have isolated a new coloring agent for lubricants, according to a recent item in Petroleum Times. After numerous experiments in their laboratories a product of the action of aluminum chloride on naphthalene—at high temperature, for a certain period, and in proper proportion — is now obtained in technically satisfactory quantities and is admirably suited for producing the desired green fluorescence. The product is a hydrocarbon compound containing a di-methyl-crackene or naphth-anthracene derivative. Small proportions bring a lube oil up to the

SAVES 60,000,000 hand operations

AMERICAN Precision Temperature Controllers and Pressure Controllers are now available in all sizes from ½ inch to 4 inches inclusive. The new bellows is constructed from single diaphragm units of phosphor bronze sheets, tempered to the desired hardness and tinned. The diaphragms are cupped near the edges to prevent bending strain and are corrugated for extra strength. Each bellows will expand and contract at least 60,000,000 times without rupturing.

Five advantages of automatic controllers are reported by users in many fields of industry:

1. They effect fuel savings.
2. They prevent losses of material, labor, fuel and manufacturing time, caused by spoilage and rejection of product.
3. They save labor by relieving workmen of the duties of adjusting valves and watching temperatures and pressures.
4. They guarantee uniform production.
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The Precision Temperature Controller will automatically maintain critical temperatures to within a single degree.

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Ashcroft American Gauges	A-19	American Tachometers	J-19	Hancock Forged Steel Valves	W-19
American Temperature Controllers	R-19	Ashcroft Power Control Valves	M-19		

appearance of Pennsylvania standard without affecting the other properties of the oil.

The Times also states "It is difficult and costly to isolate the fluorescent compounds in the pure state; it is preferable to dissolve the pitch or residue in oil, or to extract them with the oil, and to add an appropriate quantity of the coloring 'dope' to the lubricating oil. These processes are described in the American patents Nos. 1,708,563, and 1,708,592, and 1,708,602 acquired by the Pan-American Petroleum Company."

Another method appears in a recent edition of Petroleum Zeitschrift pertaining to similar developments in Germany. It consists of a number of treating steps, about as follows—Topped crude of the correct viscosity is diluted 30 to 40 per cent with 450 e.p. naphtha, quick heated, agitated for seven minutes with 20 pounds of 66 acid per bbl. Let settle eight to 10 hours, and give second pump of 20 to 30 pounds 66 acid and settle well. Neutralize with 0.3 per cent slaked lime, then add four per cent acid treated German clay at room temperature with thorough agitation. Settle one hour, separate earth. Add four per cent more acid clay and heat to 120°F. and not over 140°F. Agitate 10 minutes. Separate. Run off naphtha in steam still. This is said to give a pale red oil of green bloom with a treating sludge loss of 12 to 15 per cent.

Sinclair Refining Company patents 1,756,153; 1,756,-154,-155, and 156, relate to a process or system for the removal of low-boiling, polymerizable components of naphthene base crudes, as they cause tar formation in lubricants, are difficult to remove, and impair the stability, color and other properties of lubricating oils. Briefly the patented system consists of a specially designed fractionating column, have a lower treating section, a middle refluxing section, and upper dephlegmating section. Vaporized lubricant is bubbled through a hot caustic oil bath for removal of acidic components and polymerization of its tar forming components. Further, the vapors may be passed through a solid absorbent such as fullers earth. The last patent pertains to a process as described here but with application of the hot alkaline oil in a series of baths on the countercurrent principle.

THE annual survey of cracking units in this country as prepared by the Bureau of Mines, is available as Information Circular 6305. The work was done by Associate Economic Analyst, G. R. Hopkins in his usual thorough manner.

In addition to his tabulations and listings Mr. Hopkins brings to light some interesting facts in his introductory remarks.

Total cracking capacity is reported as 1,708,940 barrels through 2002 units. This is a nine per cent decrease in number of units, but a 16 per cent increase in capacity. At the time of the survey 149,900 barrels of new capacity was being erected.

Texas Gulf Coast refining district reported 21 per cent of all cracking capacity, or 359,800 barrels. The total cracking capacity of the state of Texas was 440,-370 barrels.

Production of gasoline by cracking amounted to 143,-759,000 barrels in 1929, as compared with 122,554,000 barrels in 1928; a gain of 17 per cent.

Thirty-eight different types of cracking processes are listed. Vapor phase cracking capacity has increased from 17,000 barrels in 1928 to 30,650 barrels, 1929. There is a trend toward modified cracking processes and in this survey such types as "continuous high pressure," "pipe still," and "pressure coil" appear.

An inspection of the tabulations shows the following usage of the different cracking units: Burton, 895; Dubbs, 188 units; Cross, 163 units; Holmes-Manley, 129 units; Tube and Tank, 123 units; Isom, 100 units; Buerger, (Gulf) 93 units; Coast, 80 units; Jenkins, 49 units,—these making a total of 1820 units. With Doherty units, 20 Link units, 24 Slagter units, 24 Bruin units, and 24 vapor phase units (13 of which are Gyro) the number of better known processes is brought to 1928 units, leaving a list of 74 units of various types of processes.

"DR. E. H. Leslie and Dr. H. B. Coats announce the engagement of the Leslie Laboratories of Traver Road, Ann Arbor, Michigan, in a service including physical, chemical and engineering research and development work, and also general laboratory work, in the fields of distillation, chemical treatment, dewaxing and various processing operations of the petroleum refining and natural gasoline industries," states an announcement recently accompanying a letter from Dr. Leslie.

In his correspondence Dr. Leslie states: "I have had in mind for some years that there was a definite need for a laboratory equipped to handle special problems. When I say equipped I mean both with the necessary laboratory apparatus or ordinary type as well as more special and unusual apparatus, and, more particularly, manned by a group of men competent by training and experience to deal with problems of a research and investigational nature. . . . In addition to the facilities of our own laboratory we have in Ann Arbor the facilities of the University of Michigan, including excellent technical libraries and, also, what we may regard as a special consulting staff in the shape of the entire scientific faculty."

It appears that an institution and organization such as this, should be able to render a valuable service to many of the smaller and moderate sized refineries and gasoline manufacturers not maintaining research laboratories of their own; for the problems of the industries are numerous and varied. Doctors Leslie and Coats are well known throughout the industry. Many refineries are equipped with distillation and rectification facilities of Leslie design.

Billions of Bubbles

RESPONSIBILITY

IN this age of specialization it is well to reflect occasionally on this thought:

Exactly what is the natural gasoline plant builder's responsibility to the producer? Does his responsibility end when the first graduate of gasoline comes through?

Were this the case, the gasoline plant might well be put in the category of the washing machine; it is delivered, first payment accepted, and then the installer is free to give all his time to the next prospect.

But the correctly designed gasoline plant, like the human body, is a highly specialized organism, every part bearing a definite relation to every other part. Each installation constitutes a special case.

Here is where the responsibility-conscious plant builder comes in. The tuning up of one of his plants—and its subsequent perfect functioning—is every whit as much his duty as the designing and construction of the plant itself.

In buying a gasoline plant, the producer is buying gasoline. The plant that produces a maximum of quality gasoline at a minimum of cost (properly designed plants cost less to maintain) is the plant that every foresighted producer is looking for.

Campbell-built plants are extracting 20% of all the natural gasoline produced in California. Of 32 plants built in that State within the last six years, 19 represent repeat orders.

Campbell engineers follow every one of their plants through, just as the old family doctor used to follow through "his" babies. Campbell maintains a rigid inspection service, his responsibility to the producer.

Write for Bulletin No. 7. It explains the Campbell system.

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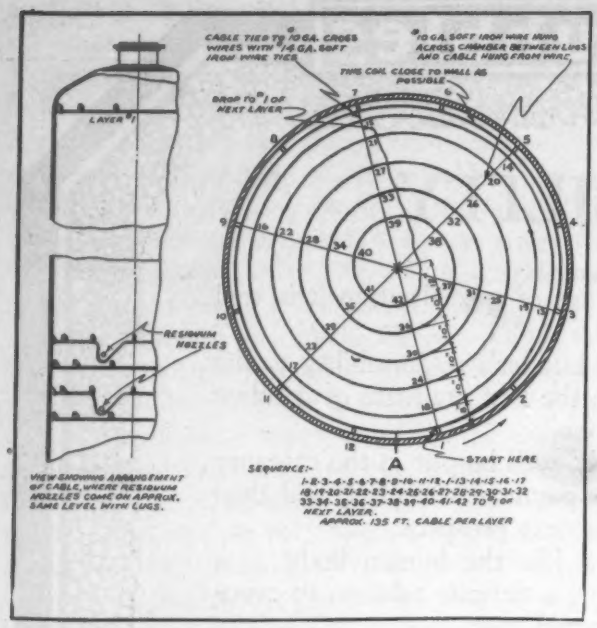
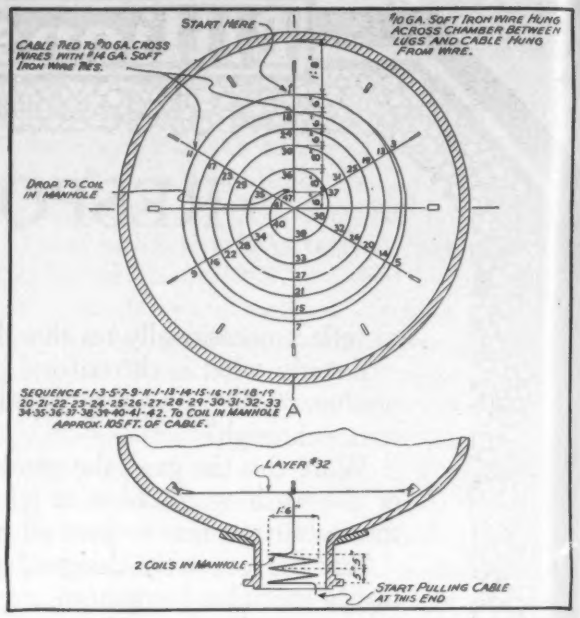

CABLE TIED TO #10 GA. CROSS WIRES WITH #14 GA. SOFT IRON WIRE TIES
#10 GA. SOFT IRON WIRE HUNG ACROSS CHAMBER BETWEEN LUGS AND CABLE HUNG FROM WIRE.
THIS COIL CLOSE TO WALL AS POSSIBLE
DROP TO #1 OF NEXT LAYER
LAYER #1
RESIDUUM NOZZLES
VIEW SHOWING ARRANGEMENT OF CABLE, WHERE RESIDUUM NOZZLES COME ON APPROX. SAME LEVEL WITH LUGS.
SEQUENCE:-
1-2-3-4-5-6-7-8-9-10-11-12-1-13-14-15-16-17
18-19-20-21-22-23-24-25-26-27-28-29-30-31-32
33-34-35-36-37-38-39-40-41-42 TO #1 OF NEXT LAYER.
APPROX. 135 FT. CABLE PER LAYER
START HERE
A


START HERE
#10 GA. SOFT IRON WIRE HUNG ACROSS CHAMBER BETWEEN LUGS AND CABLE HUNG FROM WIRE.
CABLE TIED TO #10 GA. CROSS WIRES WITH #14 GA. SOFT IRON WIRE TIES.
DROP TO COIL IN MANHOLE
SEQUENCE-1-3-5-7-9-11-1-13-14-15-16-17-18-19
20-21-22-23-24-25-26-27-28-29-30-31-32-33
34-35-36-37-38-39-40-41-42. TO COIL IN MANHOLE
APPROX. 105 FT. OF CABLE.
A
LAYER #32
2 COILS IN MANHOLE
START PULLING CABLE AT THIS END

Cutting Cost of Coke Removal

By RUSSELL BYRON WILLIAMS
American Cable Company

BECAUSE operators of cracking stills are constantly on the lookout for both methods and means for reducing the cost of coke removal, the experience of an Indiana operator with a new type of wire rope will be interesting.

Formerly this operator had been using wire rope of ordinary construction and found that he was "lucky if he got four months' service out of it." The average was considerably less. He then made a trial using a similar rope, but of preformed construction, and with the gratifying result that this rope gave five months and seven days of service before it finally failed by breaking. Comparing the results of this test with what previously had been considered good performance there is a gain in life of about 30 per cent. If the life shown by the preformed rope in the test be taken as average and compared with the average formerly experienced, the gain would more nearly approximate 50 per cent.

In cracking still service, of course, the gains to be secured through increased wire rope service are not entirely in the cost of rope itself. Wire rope breakage in this service means additional labor to complete the removal of coke, as well as an appreciable delay in getting the still back into service. Naturally, anything that reduces the frequency of cable failure cuts down ultimate removal cost from several angles.

The preformed rope is easy to load into the still due to the fact that in this design every wire and every strand is given its helical shape before the rope is assembled, so that there are no initial stresses in the material. Every element of the rope being in a state of repose, so to speak, not only makes the rope tractable to handle but also gives it advantage in meeting the stresses and strains of service.

It is believed that this freedom from initial strain in wires and strands is largely responsible for the ability of the rope to withstand for a materially longer time the sharp bending and the other abuse that rope must stand in breaking out solidified coke. However, the lesser tendency of the rope to get into kinks may have something to do with it. The method of loading the preformed rope into the still was in general the same as had been used previously by this operator. The details of the loading system, together with all dimensions, are shown in the accompanying drawings.

Close-ups of the cable, taken subsequent to its failure by breakage, indicate not only its general appearance and condition after five months and seven days of service, but also the type of cable employed. It was of ¾-inch diameter and the material was improved plow steel. If the experience of this operator is repeated in general practice it will demonstrate that the use of the higher quality material and construction is the more economical practice even in a class of service where every operation is a severe form of abuse and the mortality of equipment is inevitably high. That this may be expected is indicated by the experience of a refinery in the Southern Illinois field, which also made a trial of ¾-inch improved plow steel rope of preformed construction and secured six months and 28 days of service from it, as compared with a maximum of four months from rope of the same size and material, but of ordinary construction.

Petroleum Distillation Equipment From Blue Print to Shipment Under One Roof

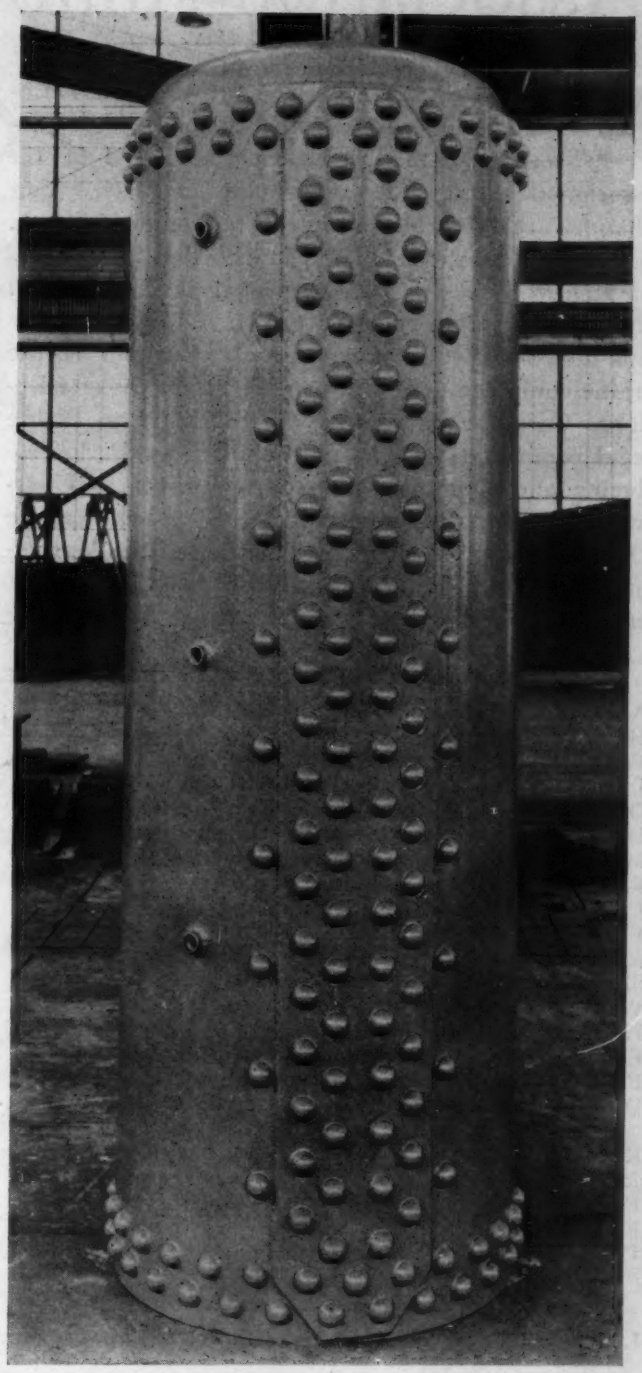
The heaviest of plate work—

is at all times welcomed in the modern plant of the J. P. Devine Manufacturing Company. We are equipped with both men and machinery to give prompt and speedy service at remarkable savings to the purchaser.

The high pressure exchanger shell 36″ diameter by 12″ high is made of 1½″ plate. It is quadruple riveted.

Distillation units designed and built by the J. P. Devine Manufacturing Company assure lowest possible full consumption; maximum recovery of distilled product; the elimination of re-running through sharp fractionation and low consumption of power, steam and cooling water. "Petroleum distillation equipment from blue print to shipment under one roof" makes possible many economies. May we tell you of them?

Charles P. Devine
Pres.



J. P. DEVINE MANUFACTURING CO.

Incorporated

Main Office and Plant, Mt. Vernon, Ill.

NEW YORK	CHICAGO	BOSTON	HOUSTON, TEXAS
25 W. 43rd St.	Loop Center Building 105 W. Madison St.	93 Massachusetts Ave.	*Represented in Principal Oil Centers*

Western Petroleum Refiners Association Announces Committees

L. R. CRAWFORD, president of Western Petroleum Refiners Association announced the personnel of the permanent committees of the association during the latter part of July. Few changes are noted in the committee membership. A. S. Hopkins, president of the Standard Oil Company of Kansas, succeeds Mr. Crawford as chairman of the manufacturers committee. H. A. Trower, Phillips Petroleum Company, is new chairman of the traffic committee. P. C. Spencer, Producers and Refiners Corporation, was appointed chairman of the legal committee, and P. F. Gwinn, Iowa Park Producing and Refining Company, continues as chairman of the export committee. P. M. Miskell, Empire Oil & Refining Company, is chairman of the Marketing committee. Following is a list of the committees and their membership:

MANUFACTURERS COMMITTEE

A. S. Hopkins, chairman, Standard Oil Company of Kansas;
H. W. Camp, Empire Oil & Refining Company;
Walter Miller, Continental Oil Company;
J. M. Wadsworth, Independent Oil & Gas Company;
Dr. E. R. Lederer, Texas Pacific Coal & Oil Company;
Dr. F. W. L. Tydeman, Shell Petroleum Corporation;
M. P. Youker, Phillips Petroleum Company;
R. J. Black, Sinclair Refining Company;
J. A. Sartori, Producers & Refiners Corporation;
B. P. Crittenden, Louisiana Oil Refining Corporation;
R. T. Colquette, Root Refining Company;
Slyvester Dayson, Lion Oil Refining Company;
W. F. Simms, Panhandle Refining Company;
H. D. Bennett, Mid-Continent Petroleum Corporation;
E. A. Metcalf, Standard Oil Company of Kansas;
F. N. Williams, Simms Oil Company;
D. H. Cristman, Shreveport-El Dorado Pipe Line Company;
K. J. Smith, Skelly Oil Company;
J. B. Edwards, White Star Refining Company;
F. E. Holstein, Barnsdall Refineries, Inc.;
E. J. Mary, Cosden Oil Company;
J. V. Gaudet, Chalmette Petroleum Corporation.

FINANCE COMMITTEE

L. R. Crawford, chairman, Producers & Refiners Corporation;
George D. Locke, Barnsdall Refineries, Inc.;
M. J. Grogan, Louisiana Oil Refining Corporation;
E. H. Eddleman, American Refining Properties.

TRAFFIC COMMITTEE

H. A. Trower, chairman, Phillips Petroleum Company;
F. H. Walker, Shreveport-El Dorado Pipe Line Company;
B. J. Burchett, Shaffer Oil & Refining Company;
D. F. McCarthy, Producers & Refiners Corporation;
H. W. Roe, Mid-Continent Petroleum Corporation;
E. W. Sieboldt, Shell Petroleum Corporation;
A. F. Winn, Skelly Oil Company;
S. B. Myers, Independent Oil & Gas Company;
H. W. Yeager, American Refining Properties;
C. R. Musgrave, Phillips Petroleum Company;
W. W. Klingensmith, Transcontinental Oil Company;
H. G. Watts, Derby Oil & Refining Corporation;
W. B. Knight, Lion Oil Refining Company.

CREDITS AND ACCOUNTING COMMITTEE

R. R. Irwin, chairman, White Eagle Oil & Refining Company;
W. Z. Brown, Producers & Refiners Corporation;
B. H. Markham, Continental Oil Company;
J. M. Judson, Sinclair Refining Company;
F. H. Bowman, Pure Oil Company;
M. W. Bottomfield, Transcontinental Oil Company;
M. A. Chambers, Panhandle Refining Company;
H. M. Edinger, Barnsdall Refineries, Inc.;
Charles Klein, Mid-Continent Petroleum Corporation;
A. J. Ahlum, Crystal Oil Refining Corporation;
R. F. Barnes, Eason Oil Company;
J. A. McCreery, Champlin Refining Company;
O. W. Crick, Independent Oil & Gas Company;
G. R. Baysinger, Lion Oil Refining Company;
O. K. Wing, Phillips Petroleum Company;
J. D. Powell, Skelly Oil Company;
H. Canon, Root Refining Company.

MARKETING COMMITTEE

P. M. Miskell, chairman, Empire Oil & Refining Company;
R. W. McDowell, vice-chairman, Mid-Continent Petroleum Corporation;
D. P. Hamilton, Root Refining Company;
M. J. Grogan, Louisiana Oil Refining Corporation;
G. W. Reed, Panhandle Refining Company;
George N. Moore, Cosden Oil Company;
F. A. Pielsticker, Skelly Oil Company;
R. R. Irwin, White Eagle Oil & Refining Company;
C. L. Henderson, Vickers Petroleum Company;
T. M. Martin, Lion Oil Refining Company;
W. L. Scott, American Refining Properties;
E. L. Miller, Shell Petroleum Corporation;
A. T. Smith, Producers & Refiners Corporation;
E. S. Karstedt, Continental Oil Company;
H. A. Trower, Phillips Petroleum Company.

LEGAL COMMITTEE

P. C. Spencer, chairman, Producers & Refiners Corporation;
J. C. Denton, Mid-Continent Petroleum Corporation;
W. P. Z. German, Skelly Oil Company.

LEGISLATIVE COMMITTEE

F. A. Pielsticker, chairman, Skelly Oil Company;
R. R. Irwin, White Eagle Oil & Refining Company;
E. H. Eddleman, American Refining Properties;
M. J. Grogan, Louisiana Oil Refining Corporation;
T. M. Martin, Lion Oil Refining Company;
L. B. McCammon, Transcontinental Oil Company.

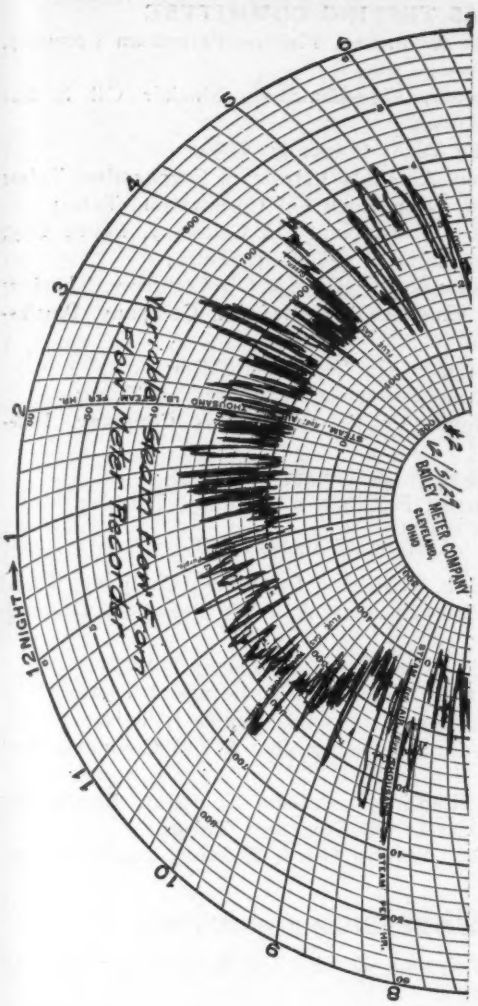
MEMBERSHIP COMMITTEE

George D. Locke, chairman, Barnsdall Refineries, Inc.;
D. G. Gray, Dale Oil & Refining Company;
P. M. Miskell, Empire Oil & Refining Company;
J. B. Atkins, Shreveport-El Dorado Pipe Line Company;
F. A. Pielsticker, Skelly Oil Company;
H. T. Ashton, Lubrite Refining Company.

EXPORT COMMITTEE

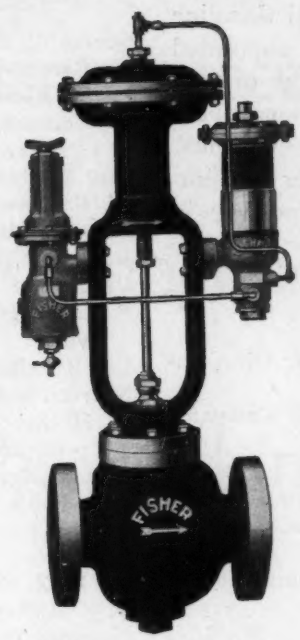
P. F. Gwynn, chairman, Iowa Park Producing & Refining Company;
R. W. McDowell, Mid-Continent Petroleum Corporation;
Dr. W. E. Winship, Chalmette Petroleum Corporation;
Victor H. Smith, White Oak Refining Company;
W. L. Lesh, Kanotex Refining Company.

CONTROL BEYOND EXPECTATION

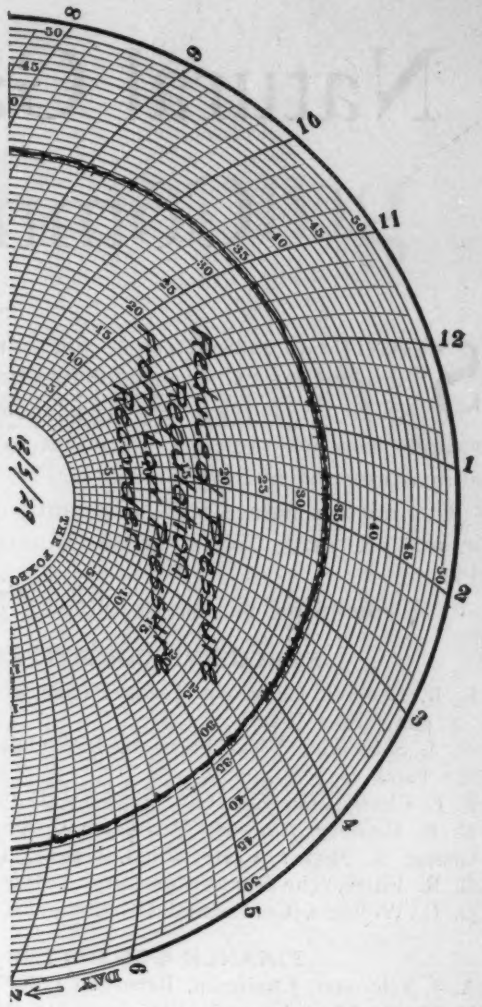


The chart above shows the variation of steam flow.

The chart at upper right shows the accurate control of reduced pressure under these severe conditions.



FISHER SERIES 2200 Regulator



The above charts from the recorders on a FISHER TYPE No. 2257 Reducing Valve Installation in the William Willheim Company, Inc., plant at Passaic, New Jersey. Henry R. Kent & Company, Engineers.

The steam flow varied 42,000 pounds per hour, yet notice the reduced pressure never varied more than one pound.

The Series 2200 can be adapted equally as well to meet your installation conditions for controlling reduced pressures, relief pressures, differential pressures, and vacuum.

You should know the full particulars of this new control. Bulletin No. 65 just released will tell you of the complete details.

THE FISHER GOVERNOR CO.

1300 FISHER BUILDING **MARSHALLTOWN, IOWA**

Natural Gasoline Association Committees Named

STANDING committees of the Natural Gasoline Association of America have been appointed by Dr. E. R. Lederer, president of the organization, who was re-elected to that position at the annual meeting in May.

Committees named will serve until other appointments are made following the annual meeting in 1931.

The committee personnel follows:

EXECUTIVE COMMITTEE

E. R. Lederer, Chairman Texas Pacific Coal & Oil Company, Fort Worth;
A. J. Schlosser, Vice-Chairman, Barnsdall Oil Company, Tulsa;
F. L. Chase, Lone Star Gas Company, Dallas;
M. E. Mockley, Amerada Petroleum Corporation, Tulsa;
George A. Shaner, Carter Oil Company, Tulsa;
E. R. Filley, The Texas Company, Tulsa;
D. C. Williams, Continental Oil Company, Ponca City.

FINANCE COMMITTEE

A. J. Schlosser, Chairman, Barnsdall Oil Company, Tulsa;
M. E. Mockley, Amerada Petroleum Corporation, Tulsa.
George A. Shaner, Carter Oil Company, Tulsa;
E. R. Filley, The Texas Company, Tulsa;
D. C. Williams, Continental Oil Company, Ponca City.

RESEARCH AND EDUCATIONAL COMMITTEE

D. E. Buchanan, Chairman, Hanlon-Buchanan, Inc., Tulsa;
R. C. Alden, Vice-Chairman, Phillips Petroleum Company, Bartlesville;
W. N. Corbet, Eagle Pitcher Lead Company, Henryetta;
E. R. Filley, The Texas Company, Tulsa;
Emby Kayo, Skelly Oil Company, Tulsa;
W. A. Melton, Deep Rock Oil Corporation, Tulsa;
E. L. Peck, Empire Oil & Refining Company, Bartlesville;
W. W. Robinson, Jr., The Texas Company, Long Beach;
S. S. Smith, Shell Petroleum Corporation, Tulsa.

GAS CONTRACT COMMITTEE

T. R. Goebel, Chairman, Skelly Oil Company, Tulsa;
J. W. Cowles, Vice-Chairman, Shell Petroleum Corporation, Tulsa;
J. H. Boyle, Hanlon-Buchanan, Inc., Tulsa;
Thos. J. Casey, Barnsdall Oil Company, Tulsa;
J. F. Dyer, The Henderson Company, Tulsa;
S. J. Fraser, Prairie Oil & Gas Company, Independence;
J. R. Freeman, Carter Oil Company, Tulsa;
Dean Hiatt, Texas Pacific Coal & Oil Company, Thurber;
M. T. Kirk, Phillips Petroleum Company, Bartlesville;
E. C. LeFevre, Empire Oil & Refining Company, Bartlesville;
G. L. Pitcher, The Texas Company, Tulsa;
L. G. Rheinberger, Sinclair Oil & Gas Company, Tulsa;
D. C. Williams, Continental Oil Company, Ponca City;
A. B. Morris, Forrest E. Gilmore Company, Tulsa.

GAS TESTING COMMITTEE

George P. Bunn, Chairman, Phillips Petroleum Company, Bartlesville;
L. G. Rheinberger, Vice-Chairman, Sinclair Oil & Gas Company, Tulsa;
C. L. Baker, The Texas Company, Tulsa;
Paul M. Bowman, Amerada Petroleum Corporation, Tulsa;
W. F. Crawford, Deep Rock Oil Corporation, Tulsa;
Paul M. Childers, Continental Oil Company, Ponca City;
J. E. Dale, Barnsdall Oil Company, Tulsa;
Dean Hiatt, Texas Pacific Coal & Oil Company, Thurber;
E. C. LeFevre, Empire Oil & Refining Company, Bartlesville;
Lee S. Miller, Carter Oil Company, Tulsa;
Norris Plank, Shell Petroleum Corporation, Tulsa;
E. H. Schoenfeldt, Prairie Oil & Gas Company, Independence;
J. M. Vaiden, Skelly Oil Company, Tulsa;
C. J. Smith, Forrest E. Gilmore Company, Tulsa.

LEGAL COMMITTEE

W. M. Z. German, Chairman, Skelly Oil Company, Tulsa;
V. C. Mieher, Vice-Chairman, Amerada Petroleum Corporation, Tulsa;
Thos. J. Casey, Barnsdall Oil Company, Tulsa;
J. W. Cowles, Shell Petroleum Corporation, Tulsa;
J. Wood Glass, The Henderson Company, Tulsa;
John Hancock, Texas Pacific Coal & Oil Company, Fort Worth;
R. H. Hudson, Phillips Petroleum Company, Bartlesville;
Lloyd Owens, Carter Oil Company, Tulsa;
Warren T. Spies, Empire Oil & Refining Company, Bartlesville.

MEMBERSHIP COMMITTEE

E. L. Peck, Chairman, Empire Oil & Refining Company, Bartlesville;
W. K. Warren, Vice-Chairman, Warren Petroleum Company, Tulsa;
W. Baker, Sinclair Oil & Gas Company, Tulsa;
F. C. Hall, The Henderson Company, Tulsa;
S. S. Smith, Shell Petroleum Corporation, Tulsa.

METERS AND REGULATORS COMMITTEE

D. A. Sillers, Chairman, Lone Star Gas Company, Dallas;
C. C. Kelley, Vice-Chairman, The Texas Company, Tulsa;
Paul M. Childers, Continental Oil Company, Ponca City;
W. F. Crawford, Deep Rock Oil Corporation, Tulsa;
J. E. Dale, Barnsdall Oil Company, Tulsa;
J. L. Griffin, Skelly Oil Company, Tulsa;
George L. Greiner, Phillips Petroleum Company, Bartlesville;
A. C. Lunkford, Carter Oil Company, Tulsa;
Norris Plank, Shell Petroleum Corporation, Tulsa;
L. G. Rheinberger, Sinclair Oil & Gas Company, Tulsa;
R. I. Short, Prairie Oil & Gas Company, Tulsa;
E. L. Stauffacher, Empire Oil & Refining Company, Bartlesville.

(*Continued on page* 140)

Vapor Phase Refining

is operating successfully in

Direct Connection with

Cross, Dubbs, Jenkins, and other

Cracking Units—

ELIMINATING ACID TREATING
AND RERUNNING

THE GRAY PROCESSES CORPORATION
961-975 FRELINGHUYSEN AVENUE
NEWARK, NEW JERSEY

(*Continued from page 138*)

OUTAGE COMMITTEE

Emby Kaye, Chairman, Skelly Oil Company, Tulsa;
W. W. Grubbs, Vice-Chairman, Barnsdall Oil Company, Tulsa;
S. B. Crooks, Empire Oil & Refining Company, Bartlesville;
M. E. Foster, Phillips Petroleum Company, Bartlesville;
F. B. Mack, Shell Petroleum Corporation, Tulsa;
A. T. Scherer, Sinclair Oil & Gas Company, Tulsa;
S. C. Harmon, Forrest & Gilmore Company, Tulsa.

PLANT OPERATORS' MEETINGS COMMITTEE

Dean Hiatt, Chairman for Texas, Texas Pacific Coal & Oil Company, Thurber;
Emby Kaye, Chairman for Oklahoma, Skelly Oil Company, Tulsa;
C. L. Brown, Sinclair Oil & Gas Company, Tulsa;
J. E. Dale, Barnsdall Oil Company, Tulsa;
W. G. Palmer, The Henderson Company, Tulsa;
F. E. Shryock, Shell Petroleum Corporation, Tulsa;
E. L. Stauffacher, Empire Oil & Refining Company, Bartlesville.

SALES MANAGERS COMMITTEE

A. T. Scherer, Chairman, Sinclair Oil & Gas Company, Tulsa;
S. B. Crooks, Vice-Chairman, Empire Oil & Refining Company, Bartlesville;
F. D. Bostaph, Texas Pacific Coal & Oil Company, Fort Worth;
H. L. Edinger, Barnsdall Oil Company, Tulsa;
M. E. Foster, Phillips Petroleum Company, Bartlesville;
A. F. Garrett, Chestnut & Smith Corporation, Tulsa;
F. C. Hall, The Henderson Company, Tulsa;
J. A. Lafortune, Warren Petroleum Company, Tulsa;
O. B. Lloyd, Continental Oil Company, Ponca City;
J. F. Nagle, Skelly Oil Company, Tulsa;
A. F. Wood, Hanlon-Buchanan, Inc., Tulsa;
S. C. Harmon, Forrest E. Gilmore Company, Tulsa.

SPECIFICATIONS COMMITTEE

E. W. Zublin, Chairman, Texas Pacific Coal & Oil Company, Fort Worth;
W. N. Corbet, Vice-Chairman, Eagle Pitcher Lead Company, Henryetta;
George P. Bunn, Phillips Petroleum Company, Bartlesville;
S. B. Crooks, Empire Oil & Refining Company, Bartlesville;
P. C. Coffin, Lone Star Gas Company, Dallas;
H. E. Felt, Warren Petroleum Company, Tulsa;
Bert Frischot, Deep Rock Oil Corporation, Cushing;
J. L. Gallagher, Sinclair Oil & Gas Company, Seminole;
H. W. Harts, Amerada Petroleum Corporation, Tulsa;
John L. Hill, Continental Oil Company, Ponca City;
Emby Kaye, Skelly Oil Company, Tulsa;
H. W. Manley, Barnsdall Oil Company, Tulsa;
S. S. Smith, Shell Petroleum Corporation, Tulsa;
I. S. Salnikow, Carter Oil Company, Tulsa;
A. F. Wood, Hanlon-Buchanan, Inc., Tulsa;
C. J. Smith, Forrest E. Gilmore Company, Tulsa.

TANK CAR COMMITTEE

W. W. Grubbs, Chairman, Barnsdall Oil Company, Tulsa;
F. B. Mack, Vice-Chairman, Shell Petroleum Corporation, Tulsa;
L. E. Frazier, Phillips Petroleum Company, Bartlesville;
J. R. Freeman, Carter Oil Company, Tulsa;
A. C. Holmes, Empire Oil & Refining Company, Tulsa;
A. T. Scherer, Sinclair Oil & Gas Company, Tulsa;
S. C. Harmon, Forrest E. Gilmore Company, Tulsa.

TECHNICAL COMMITTEE

R. C. Alden, Chairman, Phillips Petroleum Company, Bartlesville;
R. E. Baker, Vice-Chairman, Shell Petroleum Corporation, Tulsa;
H. S. Cole, Jr., The Texas Company, Los Angeles;
C. C. Chaffee, Continental Oil Company, Ponca City;
G. M. Davidson, Empire Oil & Refining Company, Bartlesville;
J. L. Gallagher, Sinclair Oil & Gas Company, Seminole;
Emby Kaye, Skelly Oil Company, Tulsa;
H. W. Manley, Barnsdall Oil Company, Tulsa;
W. A. Melton, Deep Rock Oil Corporation, Tulsa;
W. G. Palmer, The Henderson Company, Tulsa;
E. W. Zublin, Texas Pacific Coal & Oil Company, Fort Worth.

TRAFFIC COMMITTEE

C. R. Musgrave, Chairman, Phillips Petroleum Company, Bartlesville;
J. R. Freeman, Vice-Chairman, Carter Oil Company, Tulsa;
S. B. Crooks, Empire Oil & Refining Company, Bartlesville;
F. C. Hall, The Henderson Company, Tulsa;
F. G. Robinson, Lone Star Gas Company, Dallas;
R. E. Stewart, Barnsdall Oil Company, Tulsa;
Ed Starr, Texas Pacific Coal & Oil Company, Fort Worth;
A. F. Winn, Skelly Oil Company, Tulsa;
S. C. Harmon, Forrest E. Gilmore Company, Tulsa.

LIQUEFIED GAS COMMITTEE

Emby Kaye, Chairman, Skelly Oil Company, Tulsa;
J. R. Jarvis, Vice-Chairman, Lone Star Gas Company, Dallas;
R. C. Alden, Phillips Petroleum Company, Bartlesville;
G. M. Davidson, Empire Oil & Refining Company, Bartlesville;
M. L. Haider, Carter Oil Company, Tulsa;
John L. Hill, Continental Oil Company, Ponca City;
H. W. Manley, Barnsdall Oil Company, Tulsa;
W. G. Palmer, The Henderson Company, Tulsa;
W. W. Robinson, Jr., The Texas Company, Long Beach;
Paul Ryan, Shell Petroleum Corporation, St. Louis.

PUBLICITY COMMITTEE

S. S. Smith, Chairman, Shell Petroleum Corporation, Tulsa;
Emby Kaye, Skelly Oil Company, Tulsa;
H. W. Harrington, Phillips Petroleum Company, Bartlesville.

New Texas Refinery

Taylor Refining Company has started construction of a new 3000-barrel refinery at Taylor, Texas. E. L. Chapman, discoverer of the Williamson County oil field from which the crude is to be secured, and G. L. Rowsey, are officials of the new company. G. L. Rowsey has been associated with Reese S. Allen and others of Wichita Falls, with refineries at Amarillo (now Wilcox Oil & Gas Company), and Big Spring, Texas. He is an executive of Great West Refining Company at the latter city.

Waverly Sells Outlet

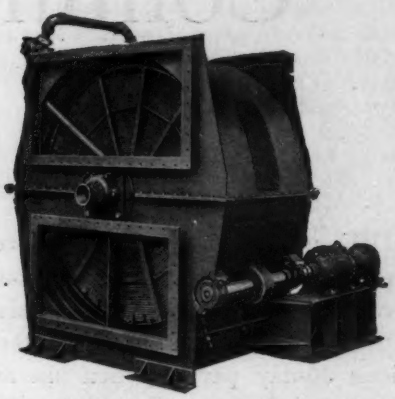
Waverly Oil Works Company has sold its stations and sales accounts to Standard Oil Company of Pennsylvania, Standard Oil Company of New Jersey subsidiary. Gasoline is delivered to the Pittsburgh area by pipe line from the parent company's New Jersey refineries. Waverly will continue to operate its Pittsburgh and Coraopolis refineries.

50 to 100% return on your investment per year

Such a return can be obtained from the utilization of waste heat by preheating combustion air—providing you select the proper equipment.

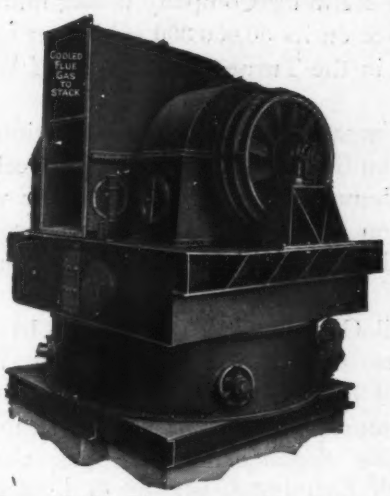
THE recovery of 70 per cent of the heat from the high temperature gases leaving stills can be accomplished only with the regenerative type of air preheater.

The Ljungstrom Regenerative Air Preheater is being successfully used for the recovery of up to 70 per cent of the heat in the gases leaving stills at temperatures from 800 to 1400 deg. Fahr., this heat being returned to the furnace in preheating the air required for the combustion of the fuel. The effects in fuel saving are from 10 to 15 per cent.



Type CHNX Ljungstrom Horizontal Air Preheater for Use with Independent Forced-draft and Induced-draft Fans

Made in three constructions for maximum flue-gas temperatures of 1000° F., 1200° and 1600°, respectively. Especially desirable for high temperature industrial work and for boiler rooms in which horizontal operation effects savings in space, building construction, ducts and fan operation.



Type CAN Ljungstrom Air Preheater with Integral Forced-Draft and Induced-draft Fans

The scroll fan housings in connection with axial fan wheels greatly increase fan capacity and decrease operating power requirement.

For temperatures over 1000 deg. Fahr., the preheater is constructed of high chrome-nickel steel throughout.

Our engineers are prepared to submit studies of the savings that can be accomplished in the installation of this equipment in your refinery.

Describe to us your operating conditions:—at least write for the new Ljungstrom Air Preheater treatise. Over 800,000 boiler hp. of Ljungstrom Air Preheaters are in service in the United States.

THE AIR PREHEATER CORPORATION
40 E. 34th St., New York

Works: **Wellsville, N. Y.; Agents in**

Philadelphia			Pittsburgh	Denver
Boston	Charlotte	Minneapolis	Cincinnati	Los Angeles
Buffalo	Detroit	St. Louis	Kansas City	San Francisco
Chicago	Cleveland	New Orleans	Houston	Tacoma

Canada: Lammers & Maase, Ltd., Montreal and Vancouver

Ljungström AIR PREHEATER

REG. U.S. PAT. OFF.

CONTINUOUS REGENERATIVE COUNTERFLOW

Refinery Capacity Expansion Continued During July

By GEORGE REID
Associate Editor

FIVE new refinery plants were announced or proposed during the past month, which indicates that the expansion of crude oil handling facilities has not slackened materially since the previous 30-day period when six new plants were indicated by reports. Outside of the United States there were four new refineries planned last month.

Taylor Refining Company has started construction of a 3000-barrel plant at Taylor, Texas, to process Williamson County crude from the Chapman field. Another crude outlet for this same field is indicated in the plans of Roy A. Westbrook, calling for a 3000-barrel refinery at Thrall, Texas.

In New Mexico the Hobbs field is to get its first refinery through the organization of Hobbs Oil & Refining Company and plans for a 2000-barrel plant. Independent Producers Refining Company, Logan, Ohio, contemplates a new refinery and cracking equipment, and Bolivar, New York, producers and business men are planning the organization of a refining company to handle the now comparatively low priced Pennsylvania grade crude oil production controlled by some of the prospective organizers.

The Argentine government has granted permission to Diadema Petroleum Company (Royal Dutch-Shell group) to erect a refinery in the Dock Sud zone of the port of Buenos Aires, and it is understood that work will start at once.

Cia. Petrolera y Refineria Eureka plans construction of a small plant across the River from Tampico, Mexico. In this area Mexican Eagle Oil Company, Ltd. (Royal Dutch-Shell group) having recently completed erection of Dubbs cracking equipment, is constructing two Gyro vapor phase units, and has requested permission from the government to establish a refinery at Mexico City, and to construct a pipe line from the Tampico fields to that point.

A new refinery for western Canada is indicated by the investigations of McColl-Frontenac Oil Company, Ltd., in a possible site ot one of several probable cities.

In western Oklahoma Westoak Gasoline Company has announced plans for the construction of an absorption natural gasoline plant near Sayre, in Beckman County, and in connection with a carbon black plant under construction by Oklahoma Carbon Industries, Inc.

Big Lake Oil Company has let contract for construction of its second natural gasoline plant in the Big Lake field of Reagan County, Texas. Signal Gasoline Company, the only other operator in this field, has also placed orders for materials for its second natural gasoline plant to be built at Santa Rita.

Regal Oil & Refining Company is beginning construction at once on its 50,000,000 cubic feet capacity gasoline plant in the Turner Valley field of Western Canada.

Pure Oil Company has begun construction of its plant in the Van field, announced several weeks ago. Phillips Petroleum Company is well under way on the construction of its Hobbs field, southeast New Mexico, gasoline plant, also announced some time ago.

Standard Oil Company of New Jersey has found it necessary to enlarge greatly its plant for the manufacture of insecticides. Continental Oil Company at Baltimore has completed installation of a modern scientific degasification and gas absorption plant, and Gulf Refining Company at Port Arthur, Texas, is enlarging capacity of its degasification plant through the addition of compressor equipment. Barnsdall Refining Company has completed installation of a direct ammonia expansion type refrigeration plant for the preparation of zero cold test bright stocks.

Refinery at Thrall

Roy A. Westbrook, Fort Worth producer, and associates, have announced plans for a 3000-barrel refinery at Thrall, Texas. Westbrook is president of Williamson County Pipe Line Company, operating a four-inch pipe line from the Chapman field to two 55,000-barrel tanks and a loading rack at Thrall, which will serve the refinery. Ten per cent gasoline and 10 per cent kerosene is to be secured by skimming. Missouri Pacific railroad is reported to have contracted for 1200 barrels of fuel oil daily. Operations are to start in September. Posted price of the crude is 55 cents per barrel.

REFINERY AND GASOLINE PLANT ACTIVITIES

New Plants – Construction Notes – Personnel Changes

Barnsdall Adds Refrigeration Unit

Barnsdall Refining Company, Barnsdall, Oklahoma, has completed installation of a new 158-ton refrigerating plant of the direct ammonia expansion type, to produce zero cold test bright stocks. The plant consists of a Carbondale ammonia compressor and four direct expansion continuous chillers capable of handling 500 barrels daily.

Argentine Refinery

Bataafsche Petroleum Maatj., Royal Dutch Company subsidiary, in its annual report, states that Argentine government, which withdrew permission to erect a refinery at Buenos Aires, has rescinded the order and the company will proceed with its erection at once. Potential crude production is reported at 6500 barrels daily.

Trade reports from Buenos Aires state that Diadema Petroleum Company will build the refinery in the Dock Sud zone of the port. The Cia Petroleo Diadema S. A. is the local subsidiary of the Royal Dutch-Shell, and is a producing company in the Comodoro Rivadavia field. Shell-Mex Oil Company of Argentina is the transporting and marketing company of the Diadema, which will now become a producing and refining company.

Two Gasoline Plants

Big Lake Oil Company has let contract for construction of an absorption gasoline plant to be located in the Big Lake field, Reagan County. Capacity is rated at 50,000,000 cubic feet of gas daily. This is the second plant for this company in this field.

Signal Gasoline Company has ordered equipment for its second plant to be located at Santa Rita. Gas production is secured from the 2400-3000 feet producing zone and the 8500-foot zone, from which four wells are flowing high gravity crude (58.0° A.P.I.) and about 50,000,000 cubic feet of sweet gas. The shallow production is sour gas, but yields four gallons gasoline per 1000 feet. The deep zone gas yields one gallon per 1000 feet.

Plan New York Refinery

Boliver, New York, producers and business men at a meeting early in July discussed the advisability of erecting a refinery to operate on crude produced from nearby fields. Capacities from 500 to 2500 barrels per day were suggested, with modern equipment provided for the manufacture of lubricants from the Pennsylvania grade crude. C. M. VanCuren acted as chairman of the first meeting. A second meeting was scheduled to be held late in July, at which time further plans were to be drawn up.

New Refinery in Mexico Planned

Cia. Petrolera y Refineria Eureka has been recently incorporated in Mexico and is to construct a small refinery at Tampico, on a site directly across the Panuco River from the city. The capacity is reported at 300 barrels daily.

Completes Stabilization Unit

Continental Oil Company, at its Baltimore plant has completed installation of a pressure distillate stabilization and gas absorption plant; operating at about 2,725,000 cubic feet per day the plant has shown over 98 per cent butane extraction. Its rated capacity is about 3,000,000 cubic feet of gas per day. Pressure distillate is stabilized in the plant by removing a light cut from the pressure distillate under pressure, leaving less than .05 per cent butane in the stabilized product. Initial boiling point of the pressure distillate is raised to 130 F. and this product shows much less vapor loss during subsequent acid treating, rerunning and sweetening.

Mary Joins Cosden

Cosden Oil Company has announced that E. J. Mary, formerly in charge of refineries for Chalmette Petroleum Corporation, Simms Oil Company, and others, is superintending operations and construction at its Big Spring, Texas, plant which has a rated capacity of 12,000 barrels daily, and is now being enlarged to 16,000 barrels capacity. Mr. Mary has been in charge of the New Orleans plant of Chalmette Petroleum Corporation for about three years, during which time he has completely modernized the plant.

Carbon Black Plant

Ethane Carbon Company has been granted permit to erect a carbon black plant in the Big Lake field, Reagan County, Texas, to burn residue gas from natural gasoline plants. Plans call for consumption of 1,000,000 cubic feet daily with possible increase of capacity to 5,000,000 feet.

New Mexico Refinery

Hobbs Oil & Refining Company has been organized by Morgan May, Hobbs, New Mexico, Bob Childers of Southwestern Investment Company and C. L. Wendt of Colorado. The company plans construction of a 2000-barrel refinery to process oil from the Hobbs field. Capital stock is $100,000. A local market is expected.

Promotions at Baytown

Humble Oil & Refining Company, at its Baytown, Texas, refinery has promoted R. E. Powell from superintendent to general manager, a newly created position. F. N. Read has been appointed superintendent, and W. R. Brison, C. E. Carlson, and A. C. Kraft, all of the operating staff, have been made assistant superintendents. Under Mr. Powell's superintendency the Baytown plant has grown to become one of the largest in the country with a rated capacity of 125,000 barrels daily.

New Ohio Plant Proposed

Independent Producers Refining Company is awaiting approval by state officials, of the charter for a refining company; plant to be erected at Logan, Ohio. Members of Southeastern Ohio Oil & Gas Producers Association are behind the move, and reports state that additional refineries may be erected at Zanesville and Marietta. The first plant contemplates the erection of a Dubbs cracking unit in addition to latest modern types of skimming plant facilities.

Propose Canadian Refinery

McColl-Frontenac Oil Company, Ltd., is considering the establishment of a new refining plant in Western Canada, according to an announcement by John Irwin, president. Winnepeg, Regina, Saskatoon, Calgary, Edmonton and Vancouver are considered as possible sites. Estimated cost is reported at $1,500,000.

Propose Refinery at Mexico City

Mexican Eagle Oil Company, Ltd., subsidiary of Royal-Dutch Shell Company, at its refinery at Minatitlan, 50 miles up the Coatzacoalcos from Puerto Mexico on the Gulf of Mexico, has completed and placed in operation a new Dubbs cracking unit.

The same company now has under construction two Gyro vapor phase cracking units of 1000 barrels daily capacity each, which are the first of this type of cracking process, developed by Pure Oil Company, to be erected in Mexico.

Mexican Eagle Oil Company, Ltd., has announced that the company has solicited permission from the government to establish a refinery at Mexico City and to construct a pipe line from the Tampico fields.

Start Refinery in Japan

Mitsubishi Oil Company, Ltd., is to start at once on the construction of its 4000-barrel refinery near Tokio, Japan, under the direction of D. D. McGregor, representative of Associated Oil Company and vice-president of the Japanese-American organization. Cracking capa-

REFINERY AND GASOLINE PLANT ACTIVITIES

city of 1500 barrels will be included. Crude will be shipped from Associated Oil Company's producing properties in California.

Navajo Plant Operating

Navajo Refining Company began operating its 3500-barrel daily capacity skimming plant, located near Kings Mill, Texas, in July. Crude supply for this plant will be furnished on contract by Cockrell-McIlroy interests from the latter's producing properties in the Texas Panhandle. John D. Wrather who headed the group of individuals that financed the Navajo Refining Company's project, is also identified with Amarillo Producers & Refiners Corporation, which is operating a plant at Pyote, Texas, and the Del Rio Refining Company, which is operating a plant at Del Rio, Texas.

Old Dutch Resumes

Old Dutch Refining Company is now operating under the supervision of C. M. Ridgeway, formerly with Smith Engineering Company, Kansas City. E. G. Guy, formerly in charge of construction and operation of the plant, has resigned that position. Mr. Guy was formerly with Orient Petroleum Company, Wichita Falls, and for several years has specialized in production of naphthas.

English Plant Ordered

Omnium International de Petroles has ordered from A. F. Craig & Company, Ltd., Paisley, a new distillation plant for the treatment of 5000 barrels of crude oil daily, Petroleum Times, London, states. The plant will be constructed from plans by Winkler-Koch Engineering Company, Wichita, Kansas. Latest type modern auxiliaries will be required.

Hobbs Gasoline Plant Building

Phillips Petroleum Company is well under way with construction of its natural

GAS BURNERS

Flame Burners
Short Flame Burners
Flameless Burners

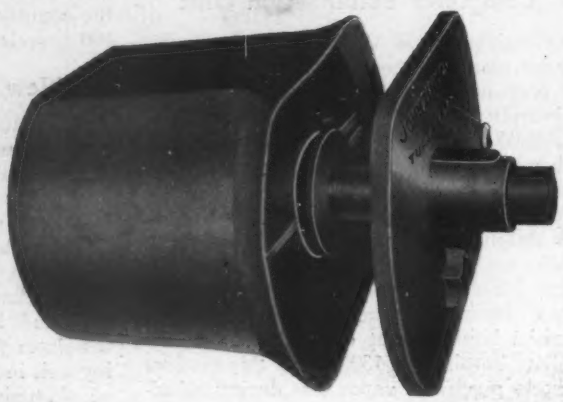
Special Burner for Gasoline Plant and Refinery work.

Burns Rectifying column and Still gases with a short flame.

JOHN ZINK CO.

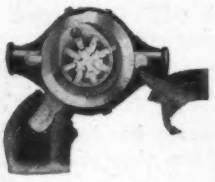
Oklahoma Natural Gas Bldg.
Phone 4-9838

TULSA, OKLAHOMA



A "4-Way" Die Stock

No loose bushings to bother with! A simple movement of the guide cam accurately centers the tool on the pipe.



Set it to size—that's all and in the twinkling of an eye you have changed dies from one size to another.

No. 6 BEAVERETTE

THREADING ¼ to ¾ inch
—and "no loose parts"!

If you believe in buying advantages instead of just "tools" the Beaver catalog of die stocks, pipe cutters, power units and grooving tools will be of interest and value to you. Write for your copy.

For more than 20 years this compact little die stock has been a popular favorite in pipe shops the world over. During this time many die stocks for threading ¼ to ¾ inch pipe have entered the market—but the leadership of No. 6 Beaverette has been unaffected because of its self-contained and adjustable advantages. Each year finds an increasing number who adopt it as standard equipment.

We frequently learn of Beaverettes which have been giving the fullest measure of satisfaction for 10 and 15 years.

Many fitters value the Beaverette so highly that they keep it under lock and key when not in use. When pipe fitters feel this way about a die stock, it is a good tool to put in every tool kit.

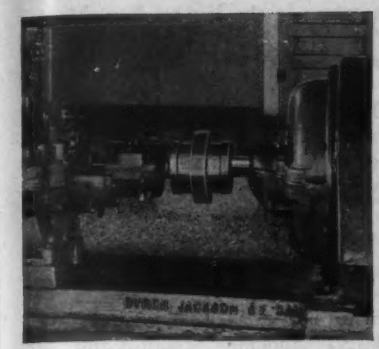
All leading supply houses stock it. Write for Bulletin "B"

THE BORDEN CO., 520 DANA AVE., WARREN, OHIO

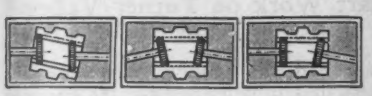
Die Stocks
Pipe Cutters

BEAVER

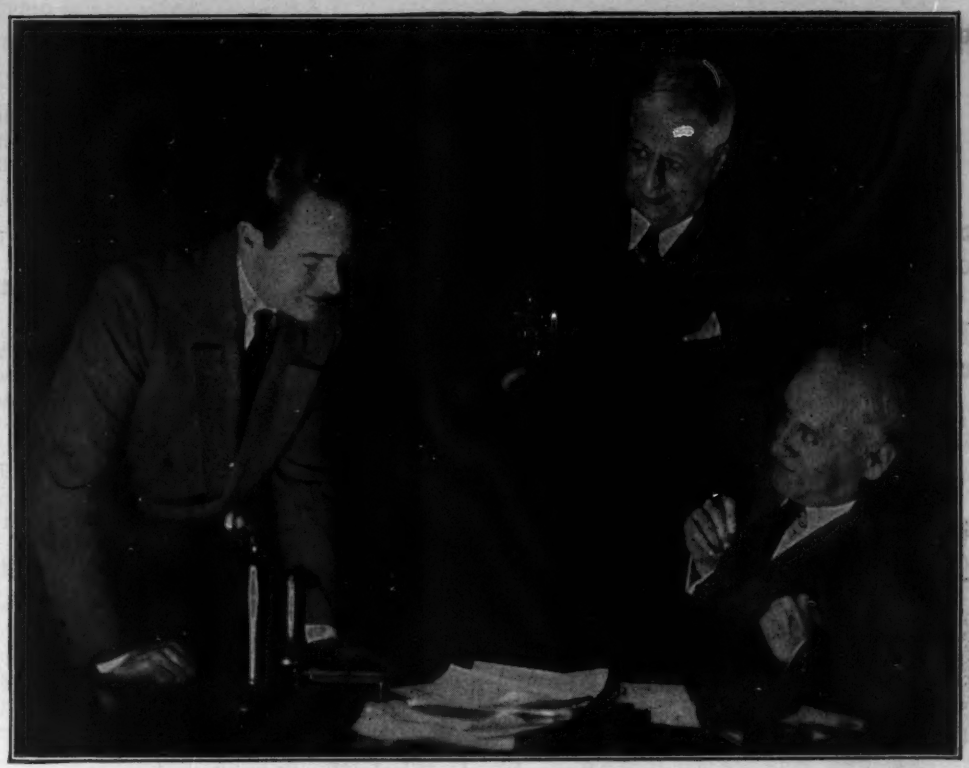
Power Units
Grooving Tools



Fast's Coupling on Byron Jackson pump assembly at Maud station of Oklahoma Pipe Line Company.



Two spur gears, one on each shaft end, mesh in oil with the internal gears of a floating sleeve, the entire assembly revolving as one unit, misalignment being taken up between the gear faces.



"Now we can stop coupling break-downs"

"WELL, this last test proves that there is a way to stop coupling break-downs. Fast's Self-Aligning Coupling does the trick."

Most shut-downs for coupling repairs are caused by the fatigue and failure of flexible parts such as pins, springs, bushings, discs and grids. Eliminate these flexible members and you banish that trouble.

That's what Fast did when he designed his Self-Aligning Coupling. His simple mechanical principle has established a new era in coupling practice. See the three small diagrams above. Two spur gears are in complete and continuous mesh with the internal gears of a floating sleeve. The entire assembly rotates as one unit, the misalignment being taken up between the lubricated faces of the gear teeth.

The lubrication principle is just as simple. The casing is partly filled with oil. As the coupling revolves the oil is distributed between the gear teeth by centrifugal and capillary action. There is no metal-to-metal contact and therefore no wear. Fast's Couplings become a part of your permanent transmission equipment and with the same care will last as long as the connected machines.

Think what freedom from coupling shut-downs will mean to you. Thousands of plants throughout the country have forgotten coupling troubles by standardizing on Fast's. They insist on Fast's coupling for all new installations and for replacements.

Mail the coupon to the Bartlett Hayward Company and receive a free copy of the new 10th Anniversary Catalog giving complete details of Fast's Self-Aligning Couplings and their application in your industry.

FAST'S COUPLING

Self-Aligning

NO FLEXIBLE MATERIALS

—*Send for* NEW *Catalog*— — — —

THE BARTLETT HAYWARD CO.

216 Scott Street - - Baltimore, Md.

Send me the free bound copy of the new Fast's 10th Anniversary Catalog showing varieties of designs and installations, containing valuable data on coupling installation.

NAME_____

FIRM NAME_____

ADDRESS_____

Which Man

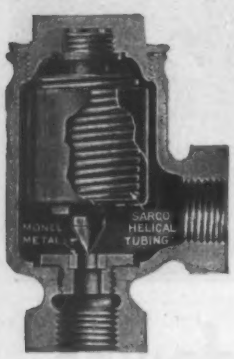
gets the most out of his steam power?

Two engineers put in steam traps.

One installed big, mechanical traps at a few of the worst condensation points and had to leave other bad spots untrapped because he could not get enough money for additional high-priced traps.

The other man had the same amount of money and bought Sarcos. He paid only a third as much per trap, so was able to put them in three times as many points in the system.

The first man had to spend a lot of money to dig pits and erect platforms for his traps. And he wasted power at the points where he should have had traps—but hadn't.



The second man had no installation expense. He just screwed the Sarcos in the pipe line—they are small enough to go anywhere you can put an ell. They adjust themselves automatically to any steam pressure from 0 to 100 lbs.

His Sarcos are sending condensate back to the hot well *hot*, as fast as it forms, so that it doesn't take as much heat to re-convert it into steam as if it were collected and cooled off in a big trap before being returned. His steam lines are *kept* drained *all* the time.

The proof? We'll send you a Sarco on free trial. Put it in the worst place you have. Leave it there a month. Then, if you have the slightest doubt, return it to us. But you won't.

Booklet S-95 tells the whole story. Write for it.

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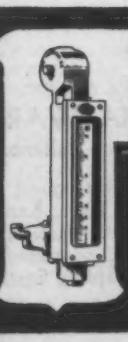
SARCO STEAM TRAP



Flow Meters

THE MERIAM CO.

1954 West 112th St., Cleveland, Ohio

gasoline plant in the Hobbs, New Mexico field. The plant will consist of two units to handle 40,000,000 cubic feet of gas daily. Installation cost is reported at $750,000. One unit will operate at well pressure, the other is being equipped with compressors. The plant is three miles west of the town of Hobbs.

Pure Building Plant

Pure Oil Company has started construction on a new absorption natural gasoline plant on the Peter's Lease, Section 3, Nacogdoches School Land Survey, in the Van area, Texas. Gas capacity is to be 5,000,000 cubic feet daily.

Start Work on Turner Valley Plant

Regal Oil & Refining Company announces that it will increase the capacity of its Calgary refinery by 50 per cent, and will begin construction of the first unit of an absorption gasoline plant in the Turner Valley field with a daily capacity of 50,000,000 cubic feet. Cost is reported at $300,000.

Shell Plant Completion Near

Shell Petroleum Corporation, at its Wood River, Illinois, refinery, is nearing completion of construction of its new 10,000-barrel True Vapor Phase cracking plant. This unit, which is reported to be the largest cracking unit in capacity, is to be placed in operation some time in September.

Olney Plant Operating

Southland Refining Company, Olney, Texas, which was incorporated by Chas. T. Wolverton and M. S. Mullins with a capital stock of $30,000 began operating its 750-barrel refinery on July 10. A portion of the equipment came from the dismantling of old Ranger Refining Company's plant at Ranger, Texas. This company was incorrectly reported in these columns last month as the Wolverton Refining Company.

Sayre Gasoline Plant

Westoak Gasoline Company has announced plans for construction of a gasoline plant near Sayre, in Beckman County, western Oklahoma, which will process gas from the Sayre gas field. Cost is estimated at $125,000. This is part of the project recently reported in these columns calling for construction of a large carbon black plant in this territory by Oklahoma Carbon Industries, Inc. C. K. Springfield is vice-president and general manager of Westoak Gasoline Company. C. H. Seegar is in charge of construction of the carbon black plant.

Enlarge "Flit" Plant

Standard Oil Company of New Jersey has awarded contract to the Austin Company, for the design and construction of a building at Linden, New Jersey, to provide additional space for the manufacture of its insecticides, such as "Flit." Estimated cost is $200,000.

New Equipment for the Modern Plant

Automatic Ratio Control

BAILEY METER COMPANY

Bailey Meter Company, Cleveland, announces a ratio control for the mixing of gases or liquids in any desired proportion.

This control finds many applications in oil refineries and process industries where mixtures of fluids must be definitely proportioned in a given ratio to secure the best results.

Air and fuel for combustion in industrial furnaces may be automatically proportioned by this control so as to secure maximum fuel economy. A control of this kind can be applied to both liquid and gaseous fuels or to a combination of the two in such a way as to insure high combustion efficiency consistent with economical operation. Mixing of two or more gases or liquids to form a low cost fuel may also be accomplished by this control.

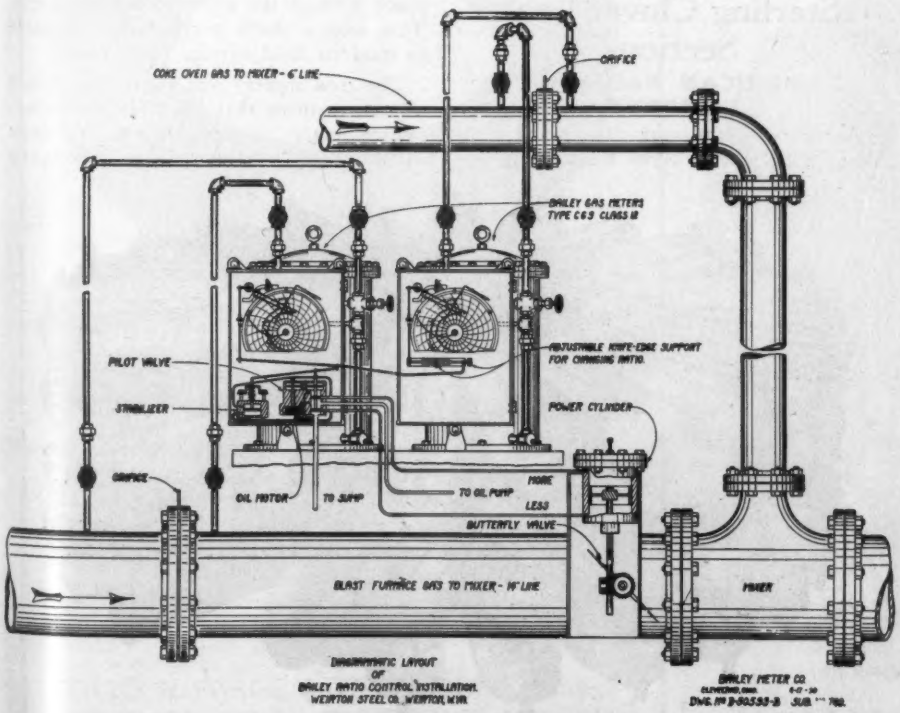
An accompanying illustration shows an installation of Bailey ratio control.

As noted from the accompanying drawing the control is operated by hydraulic pressure. Any change in the rate of flow line is immediately reflected by the Bailey gas meter connected to that line. The recording mechanism of this meter is connected through a system of linkage to a pilot valve, stabilizer and Bailey gas meter, which meter is in turn connected to the gas line. If the flow of gas increases, the linkage moves so as to raise the pilot valve, allowing oil pressure to be applied to the "more" side of the power cylinder. At the same time, this movement opens the "less" side of the power cylinder to drain. The stabilizer tends to counteract the impulse given by the gas meter. This counteracting effect of the stabilizer is secured by connecting the "more" oil line to the upper chamber of the stabilizer. As pressure is applied to the "more" oil line and the "less" side is open to drain, the stabilizer piston moves downward and tends to return the pilot valve to a neutral position which in turn tends to equalize the pressures on either side of the stabilizer, causing it also to take a neutral position.

Bailey Ratio Control—see diagram below

The stabilizer permits of a quick acting control which does not over-travel or hunt.

Any desired ratio between the two component parts of a mixture can be secured by selecting the proper ratios for the meter orifices. A further adjustment or change of ratio can be had by use of the ratio changing device which is simply a movable pivot supporting the linkage in the right hand meter casing.



Bailey Ratio Control

Gas-Dust Separator

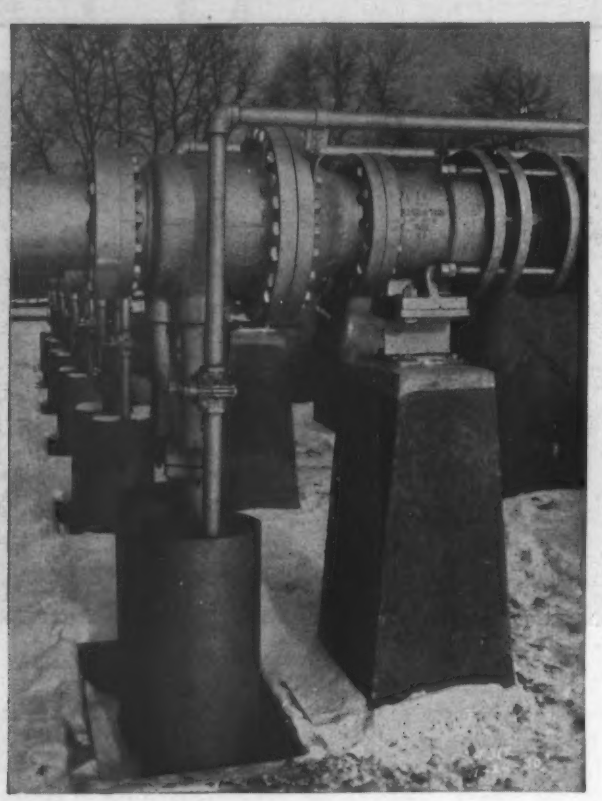
CENTRIFIX CORPORATION

Centrifix Corporation, Cleveland, Ohio, is now manufacturing and marketing a new dust separator for natural gas lines for removing grit, dust, etc., before the gas goes into the booster pumps or compressors.

A four-page, loose-leaf bulletin, No. 155, has recently been published to describe and picture this product. A photograph of an installation showing six Centrifix 12-inch dust separators is carried on the cover of this bulletin, and is used here to show the installation.

A stationary motor or tuyere whirls the moving gas and the tuyere blades are

NEW EQUIPMENT FOR THE MODERN PLANT



Centrifix Dust Separator

cast in such a manner as to act as a vortex breaker. A rib affair in the separator serves to momentarily retard the forward motion of the dust and to direct it to two ejects.

There are no moving parts in the Centrifix dust separator. The whirling motion is imparted to the gas as it flows through the stationary tuyere blades. The centrifugal action thus created throws the dust to the outside of the separating bowl, then through the two tangential ejects into the quiet area of the dust pockets, where it settles to the bottom.

The separator consists of a cast steel body, steel for 250-pound lines, iron for 125-pound and less, monel metal tuyeres cast in iron center and spacing ring and cast iron separating bowl. Flanges are faced and drilled to American standards, or to purchaser's specifications.

Detailed information is available upon request to the company.

Chemical Putty

CHARLOTTE CHEMICAL LABORATORIES

Charlotte Chemical Laboratories, Charlotte, North Carolina, is manufacturing and distributing a chemical putty for stopping leaks in lines and connections. It is for general use around chemical plants and refineries. Outlined as specific purposes of this product are the stopping of gas and acid leaks at flange joints, making tight joints at bell and spigot connections, and as a packing material for expansion joints. Outstanding features of this chemical putty are that it remains plastic and is acid and water proof.

The company's home office at Charlotte or New York office, 50 East 42 Street, will furnish detailed information upon request.

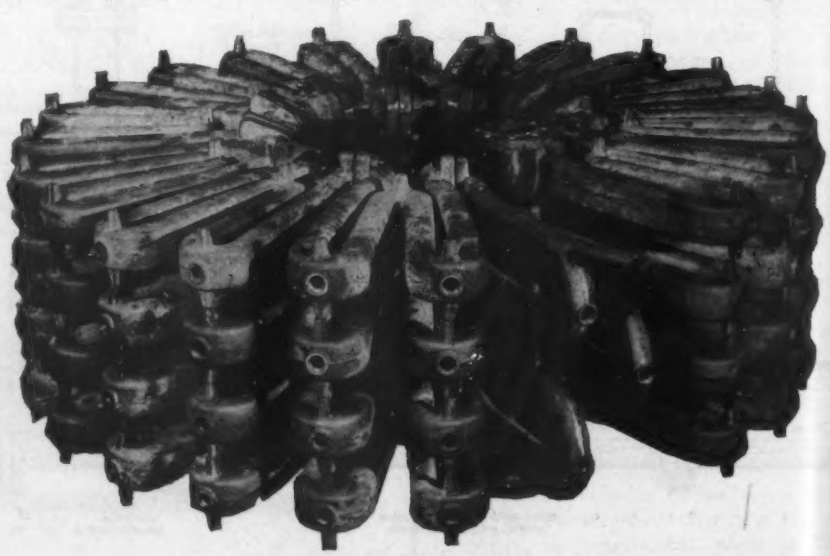
Sterling Clover-Leaf Sections

AMERICAN RADIATOR COMPANY

American Radiator Company, 40 West 40th street, New York City, announces its latest contribution to refinery equipment the Sterling Clover-Leaf sections, designed especially to give a more satisfactory reflux, knock-back or trimming coil for the control of vapor towers. One of these sections is shown here.

The sections may be readily assembled to give whatever total surface required. The separate units are small and durable, and are cast from Arco metal, a nichrome alloy cast iron.

These sections have been on test in refinery operation, being in vapor towers in shell and pipe still installations and pressure still towers for three years.



Sterling Clover-Leaf Sections

New Flow Instruments For High Pressures

FOXBORO COMPANY

Foxboro Company, Foxboro, Massachusetts, has just brought out a new high pressure recording flow meter and flow controller. The new instruments are built for operating pressures of 2500 pounds per square inch.

The picture shows a single pen 2500 pound recording flow meter. If static readings are needed a two-pen instrument with static element is furnished. When total flow readings are desired an integrator will be supplied on the instrument. The integrator is a Foxboro product and gives the flow readings without the use of any multipliers.

The new flow meters and also the new flow controllers may be mounted in place without the use of loading devices. This makes them particularly adaptable to modern field service conditions.

The new meters and controllers retain all the features that have made Foxboro orifice meters so well known. All parts of the new instruments are specifically

UNION STEAM PUMP COMPANY
BATTLE CREEK, MICH.

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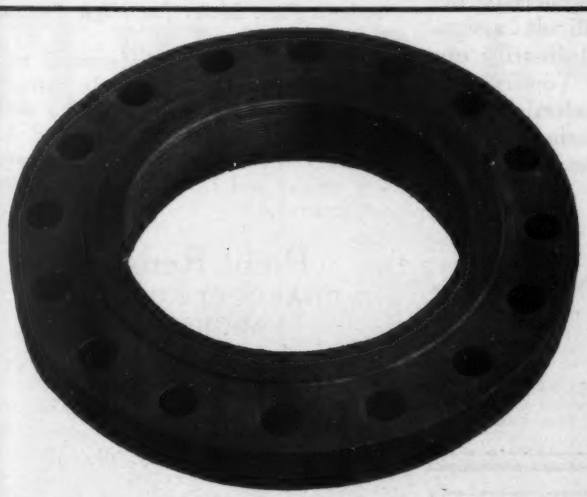
LET YOUR NEXT PUMP BE A "UNION"

REMEMBER THE NAME **REMEMBER THE "AD"**

Ask for Any Literature in which You May Be Interested



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FORGED STEEL FLANGES

Forged seamless from solid steel billets of the highest grade, Taylor Flanges meet every requirement of highest pressure steam, and high pressure, high temperature oil cracking processes.

Orders are promptly filled from a stock averaging in excess of 50,000 flanges, including all types and sizes used in modern piping practice.

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Hoists

Reversible Load Sprocket
(an exclusive feature)
insures twice the durability of usual hoist construction.
Large Roller Bearings
Solid Load Axle Alloy Steel
Cut Alloy Steel Gears
Electrically Welded Tested Chain
Forged Steel Hooks
All in Steel Suspension
Tested to 150% Rated Capacity

Union Hoists have the extra strength required for heavy work and for safe, durable, economical service. They are made by the manufacturers of UNION CHUCKS—backed by fifty years' successful experience. .. ..gue of our complete lines, including Acme Quick-Acting and Differential Hoists and Trolleys, will be sent on request.

Union Manufacturing Co.
NEW BRITAIN, CONNECTICUT
BRANCH OFFICES CARRYING STOCKS:

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Chicago, 27 S. Jefferson Street
San Francisco, 661 Folsom Street
Cincinnati, 332 Sycamore Street
I. Van Tassel, 440 First Nat'l Bank Building, Houston, Texas

An airplane view of part of a refining plant at Ponca City, Oklahoma, showing our cooling tower. This tower is 60 feet high.

Cooling Water From 150 Degrees to 74 Degrees

THE 70 degree wet bulb is the July average for Oklahoma. Our problem was to design a cooling tower which would cool water going on the tower at temperatures from 125 degrees to 150 degrees to a point within 5 degrees of the wet-bulb, cooling over a range as much as 75 degrees.

The solution to the problem was a cooling tower 60 feet high with twenty decks. That cooling tower was installed almost four years ago, and the results to date have been entirely satisfactory. Records have been kept of the daily and often hourly performance of this tower, and true wet-bulbs have been taken with a sling psychrometer as well as stationary wet-bulb readings, so that the performance of the tower has been checked in every way against the cooling results it was designed to accomplish.

Not every refining plant has a water cooling problem like this. We cite this merely to show that our engineering department can handle difficult assignments when necessary. Ordinarily our Standard Type Cooling Towers will meet your requirements perfectly. They are described in our Bulletin 283-R, a copy of which will be sent on request.

THE COOLING TOWER COMPANY, INC.

15 JOHN STREET, NEW YORK

Representatives in Principal Cities

TULSA
Whealton & Townsend, Inc.,
120 E. Brady St.

HOUSTON
J. A. Rossiter Company
410 Union Nat. Bank Bldg.

Designed for Oil, Gas and Pulverized Fuel Firing

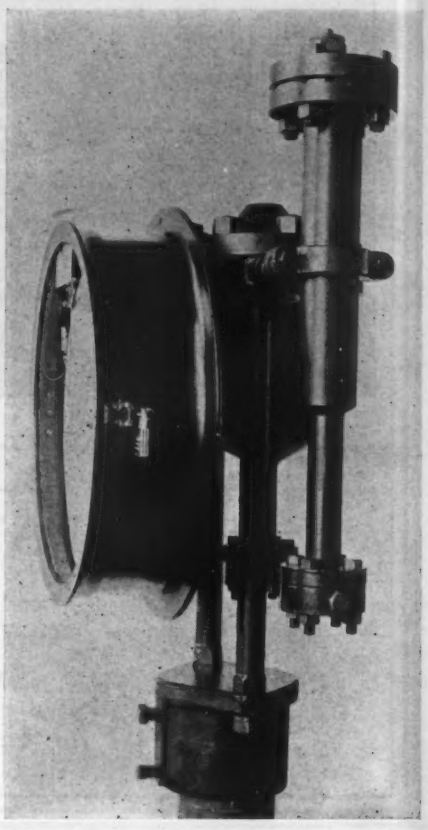
BURNERS
PEABODY

Peabody Engineering Corporation

46 EAST 41ST STREET, NEW YORK

designed for high pressure applications. All working parts are drop forgings. The illustration shows clearly their sturdy construction.

The combination of four factors; accurate coefficients, a differential measuring device that is inherently correct, a simple integrator, positive control action, and chambers that will withstand high pressures offer high pressure recording flow meters and flow controllers of rugged accuracy.



Foxboro Flow Meter for High Pressures

Point Remover

CHARLOTTE CHEMICAL LABORATORIES

Charlotte Chemical Laboratories, Inc., Charlotte, North Carolina, and 50 East 42 Street, New York City, announces Charlite, a paint removing process now being manufactured and distributed by this company.

Heavy duty cleaner No. 1 is used for stripping paint from metal trucks, tank cars and other equipment of this class. Heavy duty cleaner No. 2 is used for cleaning machine parts with the vat system.

Literature recently published by the company outlines information on the use of Charlite heavy duty cleaner No. 2, using six to eight ounces of the product to each gallon of water for vat cleaning.

Blue prints of cleaning vats will be furnished by the company upon request, while the tanks are available from the company. Complete details on these cleaning processes will be furnished upon application to the headquarters of the company or to the New York City office.

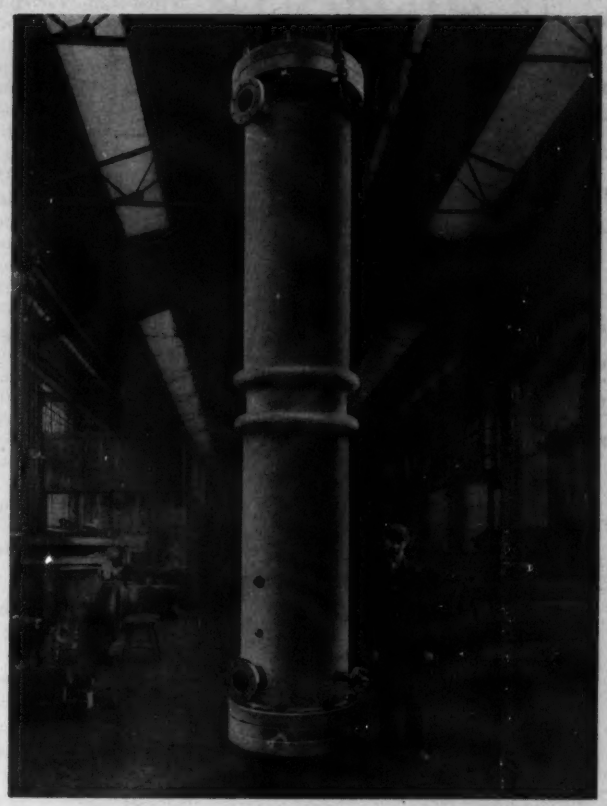
Use S & K Heat Exchangers

for refinery processes

They are built for high or low capacities, large or small capacities, standard or special operating conditions.

Single-unit, two-unit and multiple-unit designs

Send for Bulletin 12-H

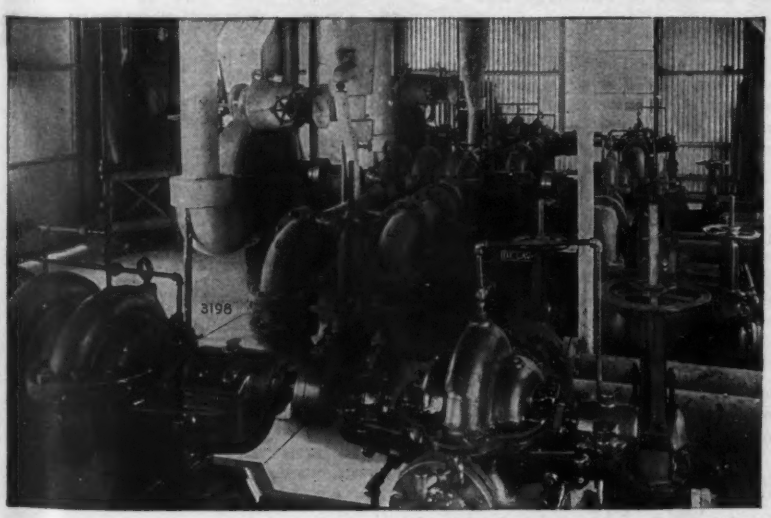


SCHUTTE KOERTING

1253 North 12th St.,
PHILADELPHIA, PA.

TURBINES and PUMPS

for High Temperatures



IN De Laval steam turbines the high pressure, high temperature steam is confined to the valve body and steam chest, at the top of the casing cover, located above and removed from the bearings, which therefore do not require water cooling.

Where required for pumping hot liquids the pumps are equipped with heat-treated, alloy steel shaft sleeves, extra deep packing boxes with metal packing and other special features.

Three De Laval turbine driven pumping units in an oil refinery. The turbines develop 150 hp. each at 2600 r.p.m., receiving steam at 140 lbs. and exhausting against 30 lbs. back pressure. The three stage pumps deliver 500 gal. per min. each of .75 specific gravity lean oil at 300° F. against 240 lbs. per sq. in., while the single stage pumps deliver 540 gal. per min. each of .80 specific gravity rich oil at 100° F. against 85 lbs.

De Laval
Steam Turbine Company
Trenton, New Jersey

Manufacturers of Steam Turbines, Centrifugal Pumps, Centrifugal Blowers and Compressors, Flexible Couplings, Double Helical Speed Reducing Gears, Worm Gears, Hydraulic Turbines and Special Centrifugal Machinery

Refinery equipment today requires large quantities of grating and treads.

ARROWHEAD has kept apace with the increasing demand and furnishes grating and treads for every requirement in the refinery industry.

ARROWHEAD GRATING AND TREADS are strong, non-slippable and serviceable under any condition, either interior or exterior.

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Send Data on

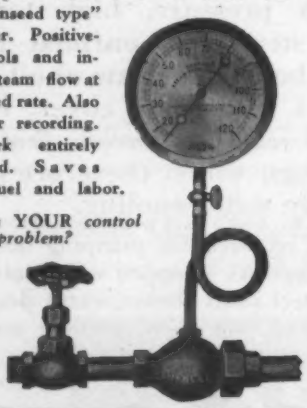
☐ The "Watermelon type" CAMPBELL Steam Flow Controller.

☐ The "Pumpkinseed type" CAMPBELL Steam Flow Controller.

☐ The Tar Baby Burner. (Handles Fuel Oils, Water Gas Tar, Acid Sludge, and Residue Fuels.)

Last month we showed you the "Watermelon type." This time we show the "Pumpkinseed type" Controller. Positively controls and indicates steam flow at the desired rate. Also made for recording. Guesswork entirely eliminated. Saves steam, fuel and labor.

What is YOUR *control problem?*



THE CAMPBELL ENGINEERING CO.,
282 South St., Newark, N. J.

Without obligating me, please send complete information on your products which I have checked above.

Name .....
Firm .....
Address .....
.....

ITEMS ABOUT MANUFACTURERS

Pittsburgh Valve Foundry & Construction Company, Pittsburgh, announces the appointment of J. F. (Fabe) Hanst, as engineer and sales representative, oil and gas division.

J. F. HANST

Hanst has had wide experience in the oil and natural gas fields, and in the mining industry, particularly in the East, where he served as engineer and branch manager for Ingersoll-Rand Company for the past 12 years. Previous to his employment by that company, and after his graduation from Lehigh University in 1907, with the degree of Engineer of Mines, he served as mining engineer and geologist with Cleveland Cliffs Iron Company, Ishpeming, Michigan; chief engineer Cortes Associated Mines, Jacala, Hgo., Mexico, and chief mining engineer, Andes Copper Company, Potrerillos, Chile.

The Louis Allis Company, manufacturers of direct and alternating current motors, Milwaukee, Wisconsin, has published an attractive eight-page bulletin covering its latest development in electrical motors. This is Type J motor, which marks a distinct advance in the design of totally-increased fan-cooled motors. The bulletin is fully illustrated, showing this new type motor disassembled, and also aswhich ranges in sizes and power from three to 100 horsepower, will be fully explained to sembled, ready for installation. This motor, details by writing The Louis Allis Company, Milwaukee headquarters.

Blaw-Knox Company of Pittsburgh, has acquired the sole manufacturing and sale rights of the Ac-me Gas Cleaner from Empire Oil & Refining Company. The product was being manufactured by A. D. Sillers of Dallas, Texas, under license agreement. The name of the unit will be changed to Blaw-Knox Gas Cleaner. An illustrated bulletin will be furnished on request.

American Meter Company has appointed R. D. O'Neil as engineering and sales representative with headquarters at 8 South 13 street, Birmingham, Alabama. He will specialize in servicing the sale of Westcott orifice meters, Linderman orifice meters, metric indicating flow meters and rate volume controllers.

O'Neil has had extensive experience in the development, construction, specifying, application, testing and checking of plant, field and laboratory instruments. After graduating as industrial engineer from the University of New Hampshire in 1926 he went to the Pacific Coast as electrician for the Southern California Edison Company. Late in 1927 he joined American Meter Company in the Metric Metal Works at Erie, Pennsylvania. There is served in several departments. He also traveled as service and sales representative, ultimately attaining the position of engineer, which he held until his recent appointment to the Southern district.

Michigan Valve & Foundry Company, Detroit, has acquired the Columbus Valve & Manufacturing Company, Columbus, Ohio, manufacturers of plug type valves.

The plug type valve now being manufactured has a wide range of pressures, and incorporated special developments of use in the oil and natural gas industries, to the process industries generally and to steam power plants.

This valve is a supplement to the line of standard gate valves, sluice gates and hydrants. It is designed for giving greater latitude than the average plug type valve, and results from the company's 78 years of valve manufacture.

Michigan Valve & Foundry Company is licensee under the Meehanite metal patents and is using this metal generally in manufacturing operations.

The Columbus plant will continue to be used exclusively for plug valve production, while gate valves, sluice gates and other products

Electrically Driven Centrifuges
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WRITE
WILLIAMS, BROWN & EARLE, Inc.
Manufacturers of Laboratory Apparatus
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TANK CARS BOUGHT, SOLD, LEASED AND REPAIRED
Repair Parts (including whole trucks) for tank and freight cars of all kinds.
RAILWAY CAR & EQUIPMENT CORPORATION
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Specialists in the field of heat transfer apparatus. We design and build Oil Vapor Condensers, Leach Fracto Control Condensers, and Heat Exchangers for Oil Refineries.

Let C. H. Wheeler engineers co-operate with you on your heat exchanger problems.

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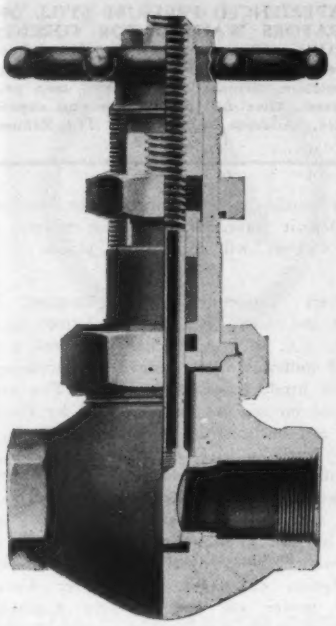

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Outside Screw and Yoke

RISING STEM UNION BONNETT

Solid Wedge and Removable Seats

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Screw Ends

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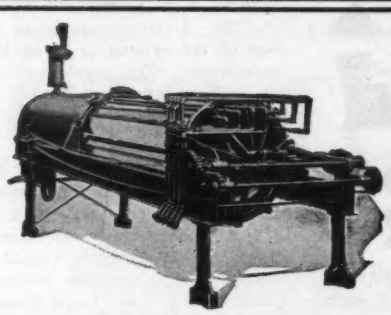

More Than a Score of Kellys Now Cleaning Up Residuum

THIS SUGGESTS TWO IDEAS:

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(2) That Kellys are the only suitable filters for this work.

These are just the basic ideas. Details can be obtained from our nearest office.

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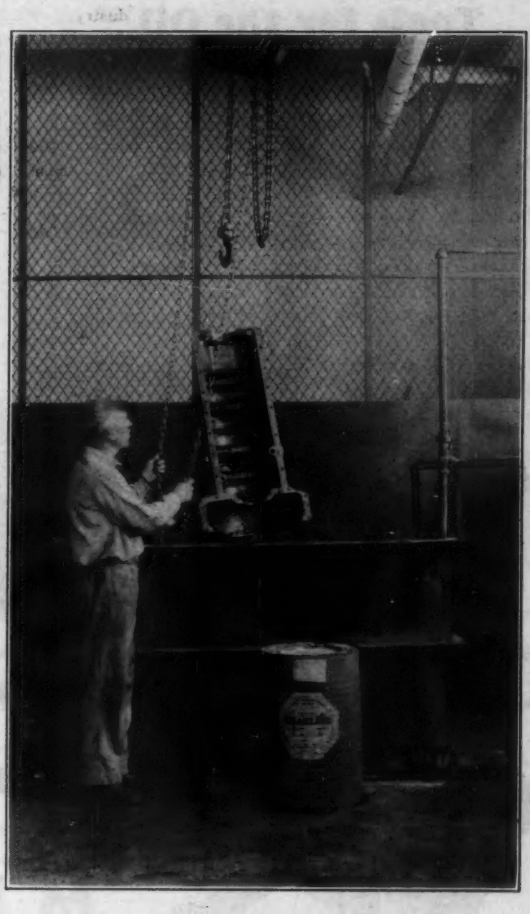

Vat cleaning of pipe line fittings, valves, gears, machine parts, bolts, etc., is easy, quick and economical when CHARLITE HEAVY DUTY No. 2 is used in the vat.

Write for full information concerning vat cleaning or any other cleaning problem.

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Charlotte Chemical Laboratories
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Charlotte, North Carolina
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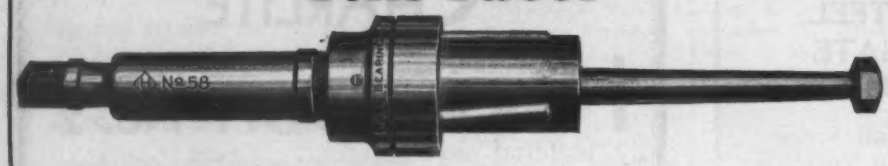
Heavy Duty Expanders for Still Tubes



Tools for the Oil Industries

Hydraulic Pressure Pumps, 8000 pounds
Tube Expanders for Cracking Still Tubes
Hydraulic Pressure Pumps, 2000 pounds
Tube Expanders for Condenser Tubes
Hydraulic Pressure Pumps, 500 pounds
Tube Expanders for Steam Boilers
Screw Punches for Structural Shapes
Tube Expanders for Pipe Work
Screw Punches for Plate Work
Flaring Tools for Still Tubes
Beading Tools for Still Tubes
Hydraulic Jacks
Hydraulic Punches

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Wilmington, Del.
Established 1870
Expanders since 1884

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EXPLOSION-PROOF MIXERS

Hy-Speed Portable Electric Mixers are the most efficient machines manufactured for blending, compounding, mixing or agitating all oils and liquid chemicals.

They clamp to any tank or vat in one minute and produce a more thorough, rapid mix . . . . more economically than by any other process. Capacities from five to 50,000 gallons.

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For mixing
LUBRICATING OILS
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ALL LIQUID CHEMICALS

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EXPERIENCED PRESSURE STILL OPERATORS WANTED FOR FOREIGN WORK. One year contract. Three hundred dollars salary. Apartment and transportation furnished. Unmarried men preferred. Give full details, age and experience. Address Box No. 59, The Refiner.

of the purchasing company will be handled by the Detroit plant. R. J. Goldie, general manager, Detroit, will direct both plants.

Petters Limited, Yeovil, England, with offices and show rooms at 75B. Queen Victoria Street, E.C. 4, London, has published a number of bulletins illustrating and describing the various products of the concern. The various types of oil engines manufactured by the company are outlined in a 24-page bulletin, No. 1754. Petter oil engines, M type, are described and illustrated in publication No. 1700B, a 24-page publication. Petters oil engines, S Type, are shown in publication 1597, a 36-page bulletin. Petter Atomic Diesel, cold starting oil engines, cover with illustrations and description 48 pages, and Petter Universal small power oil and gasoline engines are shown in a 40-page booklet covering the new 1930 model of this line. Any one or all of these bulletins may be obtained by writing the company direct at either the works at Yeovil, England or at the London office given above.

Morrison Brothers, Dubuque, Iowa, manufacturers of oil marketing, tank car and loading and unloading rack equipment, has issued a 104-page catalog covering its line of appliances. This very complete booklet is the company's 75th anniversary catalog and is designated as Catalog R. Inserted in the catalog is an eight-page price list and discount sheet pamphlet with prices and discounts effective June 25. A seven-page index section in the front of the catalog is given for the reader's convenience. The catalog has more than a thousand illustrations of Morrison Brothers products and parts.

Davis Regulator Company, Chicago, manufacturers of automatic valve specialties for oil, gas, water, air and steam flow pressure, since 1875, has completed a new factory building at 2541 South Washtenaw Avenue. Simultaneous with removal to the new offices the name was changed from G. M. Davis Regulator Company to Davis Regulator Company. Products of the company are the duplex balanced valve steam trap; steam, gas, air and water strainers; feed water balanced control valve; exhaust relief valve;solenoid balanced valve; automatic back pressure regulating valve; positive action tight closing float valve; fluid control valve; cushioned stop and check valve, visible action pressure regulator, piston and diaphragm types; and the new No. 13 pressure regulator for universal service.

E. D. Bullard Company, 275 Eighth Street, San Francisco, manufacturer of safety equipment, has recently published a 148-page catalog, which pictures and describes each of its hundreds of safety devices in detail. A copy will be furnished upon request to the company.

VALDURA PAINT

Closing Out Stock—**Dealer will sacrifice for quick sale all or part 600 gallons Valdura Paint. First class condition. Opportunity for great saving to dealers or users. Subject to prior sale. Address Box 5645, car Refiner and Natural Gasoline Manufacturer, Houston, Texas.**

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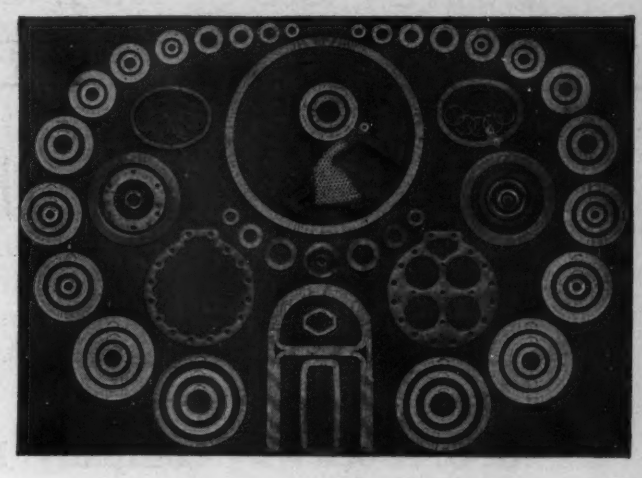
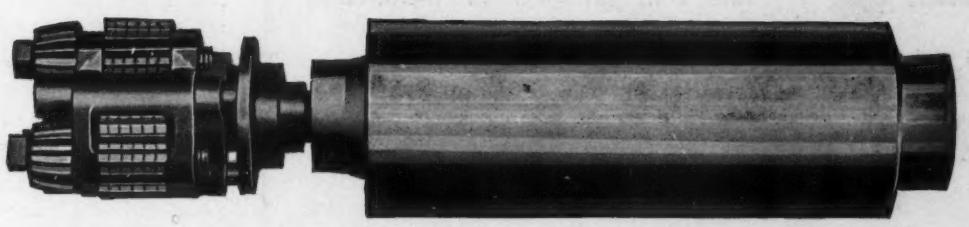
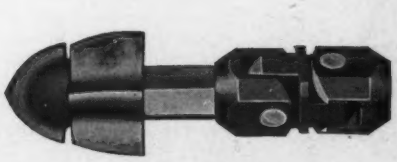


A Few Types of Goetze Gaskets

ROTO TUBE CLEANERS



Roto air-driven Cleaner for Oil Still Tubes, made in sizes for 3″ tubes and larger.



Roto Still Type Drill Head

Roto Unit Drill Head

THE ROTO CO. **Sussex Avenue and Newark St.,** **NEWARK, N. J.**

The Spiral Motion Is the Trick

That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request

B. MIFFLIN HOOD CO., DAISY, TENN.

THE NEW CYCLEOLOGY

A certain refiner. Always cycled fullers earth eight times. Then discarded. Bought a Nichols Herreshoff Furnace. Now cycles earth twenty four times. Earth more efficient after twenty fourth cycle than formerly after eighth. Probably some such possibilities in your plant. Glad to consult with you about it.

G. G. Brockway Company, Inc.
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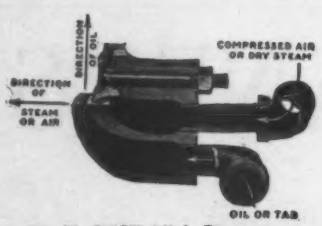

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dependable, efficient, economical, non-clogging atomizers of fuel oils, tars, acid sludges and still bottoms.

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Items About Manufacturers

Jackson Engineering Corporation, 801 East Archer street, Tulsa, has announced a new connection as sales representative for the "Unipulvo" unit pulverizer, manufactured by Strong-Scott Manufacturing Company of Minneapolis. The "Unipulvo" is an underfed unit pulverizer, designed for the efficient utilization of petroleum coke, coal or lignite for boiler fuel. Sales rights for Jackson Engineering Corporation include the whole petroleum industry, with exclusive rights in Oklahoma, Texas and Louisiana.

W. J. McART

Pittsburgh Equitable Meter Company announces that W. J. McArt has joined the company working out of the Tulsa office. He is a graduate of Case School of Applied Science, Cleveland, and has served the Foote-Burt Company, City Machine Company of Cleveland, and in 1925 was with Cyclone Fence Company.

Midwest Piping & Supply Company, St. Louis, has published an elaborate folder on the new Globack joints for high pressure piping. Globack joints are so named because the back faces of the laps are segments of globes or spheres. The flange bearing surfaces are also spherically machined. These laps contact surfaces have a cold water finish. Globack joints are improvements on the conventional Sarlum, tongue and groove, male and female, and Van Stone joints for 600, 900 and 1350 pounds, W.S.P. They are also available for other pressure ratings.

John F. Casey, president, has announced the consolidation of a number of prominent burner manufacturing concerns under the name of the Swindell-Dressler Corporation, with headquarters in Pittsburgh.

Concerns participating in the consolidation were: Duquesne Burner Service Company, Gas Combustion Company, William Swindell & Bros., and American Dressler Tunnel Kilns, Inc.

Officers of the new company are John F. Casey, president; Philip Dressler, Ralph W. Porter, Frank W. Brooke and William H. Cosgrove, vice presidents; Samuel B. Casey, treasurer; R. E. Whittaker, secretary; Lawrence A. Vincent, sales manager; H. W. Parret, Jr., manager burner division; George P. Mills, assistant chief engineer; Edwin A. Hanff, electrical engineer.

The scope of the company's activities will include industrial furnaces, electrical furnaces, combustion furnaces, tunnel kilns, both open fire and muffle type, blast furnace gas combustion equipment, natural and artificial gas combustion equipment, automatic engine stops, plant supervision and reports and engineering service.